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The risk factors of adverse birth outcomes among immigrant women in the Republic of Korea

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Abstract

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Background

The Republic of Korea (Korea) experienced increases in births from immigrant women steadily over the last 20 years, accounting for a substantial proportion of total births (4.3 %). Nevertheless, little is known about birth outcomes of immigrant women in Korea.

Methods

This study compared the birth data of immigrant and native women in Korea and explored factors affecting birth outcomes of immigrant women. A total of 68,074 singletons from immigrant women and 1,644,956 singletons from natives were examined based on the National Birth Registration Database between 2010 and 2013.

The outcomes included preterm births, low birth weight and small for gestational age (SGA). Adjusted proportions for the occurrence of preterm births, low birth weight and SGA were calculated, and performed subgroup analysis according to maternal original nationalities, maternal age, parity, and birth region. The birth outcomes of the immigrant group to a vulnerable group in Korea were compared. Add to that, the associated factors with those birth outcomes were assessed in multivariate analyses adjusted for demographic and socioeconomic factors.

Results

After adjusted for birth-related factors (infant sex, maternal age, marriage status, and parity) the adjusted proportions for preterm birth (4.9% vs. 4.6%, $p < 0.001$), low birth weight (4.2% vs. 3.6%, $p < 0.001$) and SGA (5.7% vs. 7.2%, $p < 0.001$) were significantly higher for immigrants than natives. However, after additionally adjusted for socioeconomic factors (birth region, parental education level, and occupation), preterm birth and low birth weight were significantly more favorable but SGA were still unfavorable in the immigrant group. The results were similar in the subgroup analysis for immigrants from Southeast Asia, but immigrants from China, Europe, or America revealed similar or more favorable outcomes compared to the native group. The results of stratified analyses showed that primiparous immigrant women and those between the ages of 20-34 had significantly higher proportions of adverse birth outcomes relative to native women. The results that compared to less educated parents or unemployed fathers in the native group revealed that the immigrant group had lower proportion of preterm birth and comparable proportion of low birth weight. Multivariate analysis showed that infant sex, parental ages and economic level of maternal original countries were related to preterm birth and low birth weight. After adjustment with all demographic and socioeconomic factors, the risks of preterm birth and low birth weight was lower, and that of SGA was higher in the immigrant group compared to the native group.

Conclusions

This study has provided evidence regarding the disparities in the risks of adverse birth outcomes among immigrant women and native women in Korea. However, to accurate assess the precise status of birth outcomes, and to identify the causes of adverse birth outcomes, additional information (e.g., health status of mothers and infants, monthly income, durations of residency in Korea) is needed. These data will be necessary to develop comprehensive policies that can reduce health disparities and support the successful settlement of immigrants in Korea.

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Keywords: Immigrants, Preterm birth, Low birth weight, Small for gestational age, Birth outcomes, Health disparities, Republic of Korea

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I. Introduction

A. Research Background

The Republic of Korea (Korea) has historically been considered a homogeneous country, although increasing numbers of foreign workers and marriage-based immigrants during the last two decades have altered this perception. There were approximately 1.5 million immigrants living in Korea during 2015, which accounted for approximately 3% of the Korean population. The number of immigrant families had also increased to 266,547 families in 2012, and 83% of these families were marriage-based immigrant families. The increased number of immigrant families has led to increased numbers of births to immigrant families, which accounted for 4.3% of all births during 2012 (Lee et al., 2012; Statistics Korea, 2015). Therefore, to support and care for immigrant women, the Korean government has enacted laws that require that these women be educated regarding perinatal care and receive medical check-ups during pregnancy, postpartum care, and translation services. Furthermore, immigrant mothers can receive the same benefits as their Korean counterparts, which include perinatal care, emergency treatment, neonatal healthcare, and vaccinations (Ministry of Gender Equity and Family, 2014). However, few studies have examined adverse birth outcomes among immigrant women, such as preterm birth, low birth weight and small for gestational age (SGA), and this information would be useful for assessing the effectiveness of the current policies.

Preterm birth is defined as birth before 37 weeks of gestational age, and low birth weight is defined as a birth weight of <2,500 g. There is another concept, SGA, which means that a birth weight less than the tenth percentile in the gestational age, and this is usually caused by fetal growth restriction (Martin, Fanaroff, & Walsh, 2014; World Health Organization, 2014). The sequelae of preterm birth or low birth weight include mental retardation, spastic diplegia, hearing and vision impairment,

and failure to thrive. These sequelae can increase the parents' stress and result in child abuse, neglect, and/or divorce (Kliegman, 2012). Moreover, preterm birth and low birth weight are important causes of perinatal mortality and morbidity. Preterm birth is the second most common cause of under-five mortality and babies whose birth weight were <2,500g have 20 times higher mortality rate compared to birth weight of ≥2,500g (Goldenberg et al., 2008; Kim, 2008; Lee, 2009; Rhee, 2013). If the degree of growth restriction in SGA is extreme, it can cause short-term metabolic problems and even neonatal death (Kramer et al., 1990). Less extreme SGA is known to be associated with mild, long-term deficits in growth and neurocognitive performance, and long-term associations with chronic adult diseases, such as hypertension, type 2 diabetes and coronary heart disease (Hack, 1998; Goldenberg, Hoffman, & Cliver, 1998; Barker, 1992). In addition, adverse birth outcomes place an economic burden on the family, and previous studies have reported that hospital costs are inversely related to gestational age (Petrou, 2003; Yoon, 2009). Furthermore, the parents must make out-of-pocket payments for travelling and accommodations (Tommiska, Tuominen, & Fellman, 2003). Moreover, parents typically pay more for preterm infants after the initial hospital discharge, compared to at-term infants (Petrou, 2005; Petrou, Eddama, & Mangham, 2011). Therefore, as preterm infants can have multiple comorbidities and are more susceptible to many diseases, they can create a greater economic burden, compared to at-term infants. Both preterm birth rate (4.3 in 2001 and 6.0 in 2011) and low birth weight rate (3.0 in 1995 and 5.5 in 2013) have been increased for last two decades in Korea and this might be because increased maternal age and the number of people who received artificial reproductive technology (Rhee, 2013; Yoon, 2014).

B. Research Purpose

Policies have been developed to support the increasing numbers of immigrant families and births. However, few large studies regarding birth outcomes among immigrant women have evaluated the maternal and child health statuses among immigrants to Korea. This study aimed to describe the current status of birth outcomes (preterm birth, low birth weight and small for gestational age) among immigrant women, and to compare these outcomes to those from a group of native Koreans, in order to evaluate the disparities in birth outcomes and to identify the socioeconomic factors that may affect these outcomes.

C. Research Hypotheses

(1) The proportions of preterm birth, low birth weight and small for gestational age will be higher among immigrant women, compared to those among native Koreans.

(2) There will be socioeconomic factors that are related to the birth outcomes in the immigrant group.

Ⅱ. Literature review

A. Immigrant women in Korea

There was a study on analyzing 15,341 immigrant families that a couple was composed of one immigrant and one Korean native in Korea in 2012. Over 80% of the study subjects were immigrant women (83.5%) and 16.5% was male. According to the study, approximately 80% of immigrants in these families came from Asian countries (e.g., China, Vietnam, Japan, and the Philippines, in order), and approximately 60% are currently living in the area of Korea's capital (Seoul, Incheon and Gyeonggi-do). About 80% of female immigrants and 65% of male immigrants educated less than 12 years, and the percentage of school attendance of children in immigrant families was also lower than native families (high school, 85.1% vs. 92.6%; college or over, 49.3% vs. 68.4%). Twenty one percent of immigrants reported language problems and 19.8% reported financial problems. Approximately 40% of them had experience of discrimination, especially over 50% of immigrants from Southeast Asia suffered discrimination but less than 30% of immigrants from the United States (28.5%) or Japan (29.8%) encountered discrimination. Among immigrants, 53.0% of female and 80.3% of male were employed and among unemployed immigrants, 45.1% reported the main reason of unemployment was language problem. Moreover, 89% of immigrant families had an average monthly income that was lower than the national average monthly income (Korean Women's Development Institute, 2013; Statistics Korea, 2015). According to a study on marriage based immigrant women, the main reason of their international marriage was economic problem. Especially for immigrant women from Southeast Asia, because of economic crisis in their homeland, they chose marriage based immigrant even their educational level was high (Kim, 2011).

B. Factors related to adverse birth outcomes

Preterm birth is defined as birth before 37 weeks of gestational age. It can be further subdivided into moderate/late preterm (32 to <37 weeks), very preterm (28 to <32 weeks) and extremely preterm (<28 weeks). Low birth weight is defined as a birth weight of <2,500 g, and subcategories include very low birth weight, which is less than 1500g, and extremely low birth weight, which is less than 1000g. Prognosis of neonates is directly correlated with their gestational age and birth weight. SGA is defined as a birth weight less than the tenth percentile in the gestational age (Martin, Fanaroff, & Walsh, 2014; World Health Organization, 2014). There are several known risk factors for preterm birth, low birth weight and SGA, which include placental factors (e.g., placental insufficiency and multiple gestation), maternal factors (e.g., low and high maternal age, single marital status, parity, African-American and South Asian, malnutrition, chronic diseases, and pregnancy-related diseases), environmental factors (e.g., medications, assisted reproductive technology, and country of origin), and fetal factors (e.g., genetic factors and chromosomal disorders) (Martin et al., 2014; Goldenberg et al., 2008). In addition, socioeconomic factors can affect birth outcomes, and Parker et al. have reported that almost all socioeconomic indices (maternal and paternal education, maternal and paternal occupation, and family income) were related to low birth weight among both black and white women. In that study, poor or less educated parents were at higher risk of preterm birth and low birth weight, and mothers who were professional or managerial women were at lower risk of preterm birth, compared to all other occupation categories. The researchers supposed that factors likely to be related to socioeconomic factors such as appropriate health habits during pregnancy may influenced fetal growth and premature birth (Parker, Schoendorf, & Kiely, 1994). Furthermore, a Canadian study revealed that maternal education was related to preterm birth, and that preterm birth due to educational inequalities birth have

increased (Auger, Roncarolo, & Harper, 2011). Moreover, in 2011, Shin et al. reported that parental under-education and unemployment increased the risk of preterm birth in Korea. They explained that less educated mothers were reported less likely to receive appropriate prenatal care and a low educational level may limit a person's access to jobs and other social resources that results poverty, and more likely to be malnourished and have unhealthy habits (smoking, alcohol consumption, and drug abuse) (Shin et al., 2012). Effect of parental unemployment status on adverse birth outcomes has been debatable. Some previous studies have shown that maternal unemployment was significantly associated with preterm birth (Hanke et al. 2001; Rodrigues and Barros 2008). They explained that material and financial insufficiency make maternal daily living difficult and lead to anxiety about the future, and they presumed that these stress could be an element in the mechanism of the association between unemployment and preterm birth (Hanke et al. 2001). Furthermore, women who ever worked during pregnancy tend to be better informed, have healthier behaviors towards pregnancy, easily access to health care and increased social support, and these make low risk of preterm birth among employed women (Rodrigues and Barros 2008). Whereas, others have shown that no increased risk of preterm birth among unemployed women and lower educational level and income, and they reported increased maternal stress and the risk of adverse birth outcomes affect birth outcomes rather than unemployment (Saurel-Cubizolles and Gestin 1991; Jansen et al. 2009). Some researches explained this debate with the effect of working conditions. Brett et al. reported that compared to low-strain jobs, unemployment and high-strain jobs led to an increased risk of preterm birth, and a meta-analysis showed that a significant association between physically demanding jobs and preterm births. This might be because physical and mental stress during pregnancy reduce the blood flow through the uterine arteries and affected fetal development and birth weight. Furthermore, women who have high-strain jobs are more frequently exposed

to prolonged standing or pesticides that may cause adverse birth outcomes (Brett et al. 1997; Mozurkewich et al. 2000; Jansen et al. 2009). Paternal unemployment status also can be associated with preterm births or low birth weight. Cole et al. reported that unemployed fathers have less income and higher stress in financial and marriage, and the family become low social class that may be related to low birth weight and preterm birth (Cole et al. 1983). Shin et al. explained an increased risk of preterm birth among unemployed parents in Korea with health insurance status. In Korean health insurance system, if both spouse are unemployed, they are categorized as self-employed insured and burden of insurance contribution can be increased. Therefore, they are less likely to use health care service including perinatal care and it lead to the increased risk of preterm birth (Shin et al., 2012).

C. Perinatal health of immigrants

The results of previous studies regarding birth outcomes among immigrants are debatable. For example, Mexico-born and North African-born women in the United States, France, and Belgium have good birth outcomes, and some researchers assume that immigrants may have protective behaviors that promote healthy birth outcomes (Guendelman et al., 1999). Immigrants in Mexico also had more favorable birth outcomes than natives, which the authors deduced using healthcare insurance claims data (Frank & Hummer, 2002). Several studies reported similar outcomes and explained with the healthy migrant theory, which means that healthier people are more likely to migrate and be mobile, and they could have better birth outcomes than those who do not move (Wingate & Alexander, 2006). Auger et al. reported that the healthy migrant effect was present only in mothers with low education because for immigrant women of higher education could have greater stress adapting to new environment, and it might result adverse birth outcomes (Auger et al., 2008).

In contrast, a Swedish study that was performed between 1978 and 1990 revealed that women from Asia, the Pacific Islands, and Sub-Saharan Africa had higher risks of preterm birth and low birth weight, compared to women from Finland (Rasmussen, Oldenburg, Ericson, & Gunnarskog, 1995). Another Swedish study that was performed between 1987 and 2008 reported similar results, which indicated that immigrant mothers from Asia and Sub-Saharan Africa had a higher risk of preterm birth (Urquia, Qiao, Ray, Liu, & Hjern, 2015). Furthermore, a systematic review of perinatal health among immigrants in industrialized Western countries revealed that birth outcomes varied according to the country from which the mother immigrated. For example, Asian and sub-Saharan African immigrants had a higher risk of preterm birth, which might be related to gender-based violence, posttraumatic stress disorder, language challenges, nutritional issues, and an increased risk of infection (Gagnon, Zimbeck, & Zeitlin, 2009). In contrast, immigrant women from Eastern Europe exhibited favorable birth outcomes, which might be explained by the healthy migrant hypothesis. (Janevic, Savitz, & Janevic, 2011; Wingate & Alexander, 2006).

Furthermore, a study of maternal health among marriage-based immigrant women in Republic of Korea reported that the immigrant group received less perinatal care, had a high risk of poor nutritional status, and experienced language challenges when they visited hospitals (Kim, 2009). The results of another study of maternal health among immigrant women show that 21.4% of pregnant women did not have perinatal care and only 64.1% have knowledge about contraception. And about 70% of them get perinatal health information from their family or neighborhood rather than public health centers or hospitals (Jeong et al., 2009). There are also two single-center studies of birth outcomes among immigrant women in Korea. Jang et al. reported that the incidence of congenital anomalies was higher in the immigrant group, and the authors hypothesized that this could be related to relatively old paternal age (Jang et al., 2013). The other study revealed that immigrant mothers had low body

mass index values before they became pregnant, were less likely to consume iron supplements, and that their infants were more likely to be admitted to neonatal intensive care units (Lee et al., 2013).

D. Health problems of immigrant children

Park et al. (2008) reported birth weight of 333 babies from immigrant women who gave birth in 9 tertiary hospitals from 2005 to 2008. In this report, mean birth weight of immigrant women (2,869.1 ± 685.3g) was significantly lower than that of native women (2,995.1 ± 689.8g) (Jeong et al., 2009). Hwang and Jeong (2008) reported that there were significantly different speech and language performance between children in immigrant women and native women. Children with mothers from Japan showed statistically higher performances than children with mothers from the Philippines. And the language characteristics of the children in the multicultural family had a high correlation to children's verbal and non-verbal intelligence, their mother's Korean language abilities, and educational experiences (Hwang & Jeong, 2008). Kim and Lee (2013) reported that developmental level in personality, sociality, reading and writing area in children from immigrant women was lower than natives but development of scientific thinking and mathematical thinking showed no differences (Kim & Lee, 2013).

Ⅲ. Methods

A. Data

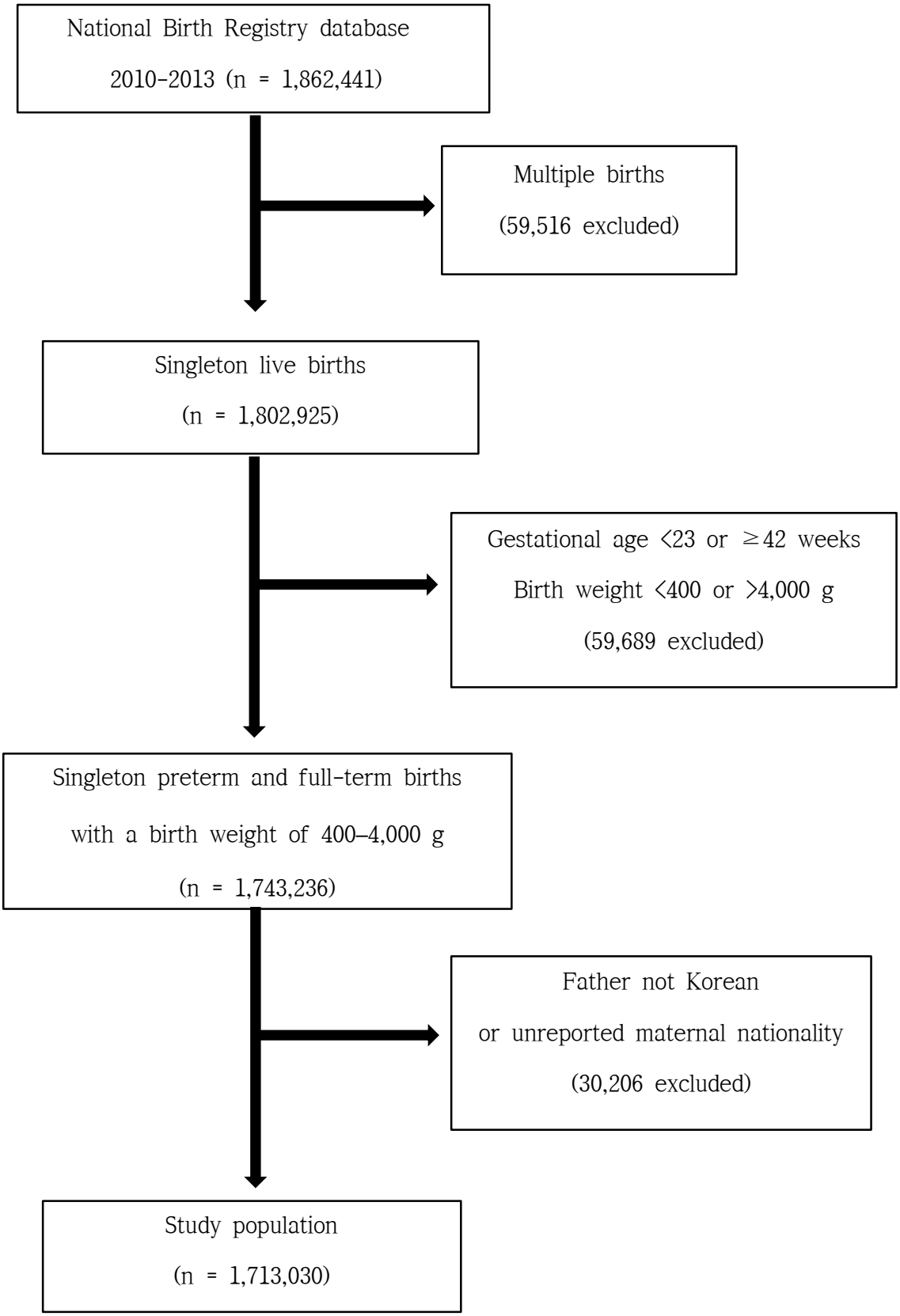
1. Study design and data source

This nationwide registry-based study examined data from 1,862,441 live births during 2010–2013, which were recorded in the Korean national birth registry. The proportions of preterm birth, low birth weight and SGA were compared among immigrant women and native Koreans, and a cross-sectional analysis of the immigrant women and native Koreans were performed to identify socioeconomic factors that affected adverse birth outcomes. In Korea, all parents must register their child' s birth within 1 month at the community centers, and must provide the following information: date of birth, maternal residential address at the time of birth, place of birth (hospital or not), parental ages, gestational age, sex, birth order in multiple pregnancy, total number of births, parental education, and parental occupation. However, whether parents are alive or not, and level of monthly income or possessions are not required to report. After 2010, parents are also required to indicate whether they are Korea-born natives or they has been naturalized, and/or their original nationality. However, immigrants do not need to fill up the duration of stay in Korea. The data was obtained from the website of Statistics Korea. Anyone can get data from the website if they register a research plan and pay cost per data quantity. The personal identification numbers were removed from the records to protect the individuals' privacy. For this reason, all birth data were treated as from different families, even if one couple gave birth twice or more during the period.

Exclusion criteria were established to compare birth outcomes of immigrant and native women. As multiple births are an important cause of preterm birth and low birth weight, 59,516 cases (3.2%) that involved multiple births were excluded. In

addition, to compare preterm birth and term birth, data for post term birth (a gestational age of ≥42 weeks) were excluded and to compare low birth weight and normal birth weight, data for large for gestational age (a body weight of >4,000g) were excluded. In Korea, a gestational age of <23 weeks or birth weight of <400g are still gray zones for active resuscitation in the delivery room thus data in these ranges were excluded to remove the potential confounding effects on these analyses (59,689, 3.2%). Moreover, to ensure that complete data regarding birth outcomes from only among immigrant women were obtained, cases in which the father's original nationality was not Korean or in which the mother's nationality was not reported were excluded (30,206, 1.6%) (Fig. 1). Thus, the final analyses evaluated data from 1,713,030 births.

Figure 1. The study flow chart



2. Variables

1) Dependent variables (adverse birth outcomes)

The dependent variables in this study were the proportions of preterm birth, low birth weight and SGA in term infants. Preterm birth was defined as <37 completed weeks of gestation and low birth weight was defined as a birth weight of <2,500 g, based on the definition from the World Health Organization (World Health Organization, 2014). SGA in term infants was defined as smaller than the gender-specific 10^{th} percentile for their gestational age (≥37 week) at birth according to the Fenton growth chart 2013 (University of Calgary, 2013).

2) Independent variables

The main independent variable in this study was the mother's original nationality, which was used to categorize women as either immigrants or native Koreans. To identify the effect of the mother's nationality on birth outcomes, the immigrant mothers' nationalities were subdivided into high-/upper-middle-income countries and low-/lower-middle-income countries, using the World Bank's data regarding each country's per-capita Gross National Income (GNI; in US dollars). For the 2016 fiscal year, low-income countries had a 2014 per-capita GNI of ≤$1,045, middle-income countries had a per-capita GNI of $1,046–12,735, and high-income countries had a per-capita GNI of ≥$12,736. Lower-middle-income and upper-middle-income countries were separated using a per-capita GNI of $4,125 (World Bank, 2015). Furthermore, for subgroup analysis, immigrants were subdivided according to the continents that their countries were belonged (Asia, Europe, America and Africa).

3) Control variables

Several socioeconomic and pregnancy-related factors in the national birth registry were controlled for. These factors included infant sex, place of birth, area of birth, parental marriage status, maternal parity, paternal and maternal age, maternal and paternal education level, and maternal and paternal occupation. The place of birth was defined as being in a hospital or not. The area of birth was categorized as metropolitan city or not, using the government-designated geocodes. Marriage status was classified as married or unmarried when the baby was born, and parity was defined as primiparous (the first delivery) or multiparous (second or over). Paternal age at delivery was categorized as <20 years, 20–29 years, 30–39 years, and ≥40 years. Maternal age at delivery was categorized as <20 years, 20–34 years, and ≥35 years. Education level was divided into high school or lower (≤12 years of education) and college or higher (≥13 years of education). Parental occupations were classified as managers or specialists, clerical support workers, service workers, blue-collar workers, and unemployed (no occupation, housewife, or student).

B. Statistical analysis

The Spearman's rank correlation coefficients were performed to assess the correlation between socioeconomic factors and with birth outcomes (preterm births, low birth weight and SGA). The χ^2 test was used to compare the proportions of adverse birth outcomes among immigrants and native Koreans, and the tests were adjusted for the control variables in two steps. First, for pregnancy- and birth-related factors (infant sex, marital status, parity, and maternal age) were adjusted for, and then socioeconomic factors (area of birth, paternal and maternal occupation, paternal and maternal education) were controlled for. Add to that, subgroup analyses for the proportion of very preterm births and very low birth weight were performed. In order to assess the differences by maternal original nationalities in immigrant

group, analyses were performed according to the continents (Asia, Europe, and America). As the number of data was limited to analysis (7 people), analysis for immigrants from Africa was not performed. Additional analyses were performed for immigrants from China and Southeast Asia as they comprised the great majority of immigrants group, and each group accounted for 26.3% and 59.9%. Furthermore, subgroup analyses were performed for birth outcomes according to maternal age (<20 years, 20–34 years, or ≥35 years), area of birth (metropolitan city or not), and parity (primiparous or multiparous) and these analyses were adjusted for the birth-related factors (infant sex, marital status, parity, and maternal age). Add to that, to compare the immigrants' outcomes with those of a vulnerable social group in Korea, the outcomes for immigrant women and the outcomes for native-born women and their partners who had low education or were unemployed were compared, and these analyses were adjusted for the birth-related factors. Additionally, comparison between the vulnerable groups and the immigrants from Southeast Asia which had the worst birth outcomes among immigrants was performed. Multivariate logistic analyses were performed to identify factors that affected adverse birth outcomes among the native, the immigrant group and both.

All analyses were performed using STATA software (version 12.1; StataCorp, College Station, TX, USA), *P*-values of <0.05 were considered statistically significant, and odds ratios (ORs) 95% confidence intervals (CIs) were used to describe the strengths of the associations.

C. Ethics statement

The survey protocol was granted an exemption by the Institutional Review Board at the Seoul National University, because this was a secondary analysis of de-identified data.

IV. Results

A. Demographic and birth-related characteristics

Table 1 shows the demographic and birth-related characteristics of the 1,713,030 birth records analyzed. In the immigrant group, the fathers were typically older and the mothers were typically younger, compared to the native Korean group (fathers: 6.2 years older, mothers: 4.1 years younger). Approximately 70% of the native Koreans were educated to a college level or higher, and approximately 70% of the immigrants were educated to a high school level or lower. The immigrant group contained a significantly greater proportion of primipara women, compared to the native Korean group (61.0% vs. 51.1%, respectively; $P < 0.001$). In the immigrant group, most mothers (62.0%) were from low-/lower-middle-income countries, and most immigrant mothers came from Asian countries (60.0%).

Table 1. Demographic and birth-related characteristics of the study population (n = 1,713,030)

Characteristics	Native Koreans, n (%) or mean (SD) (n = 1,644,956)	Immigrants, n (%) or mean (SD) (n = 68,074)	*P*-value
Infant sex			
Male	839,072 (51.0)	34,761 (51.1)	0.779
Female	805,884 (49.0)	33,313 (48.9)	
Marital status			
Married	1,623,352 (98.7)	67,646 (99.4)	<0.001
Unmarried	21,604 (1.3)	428 (0.6)	
Paternal age (years)			
Mean	33.5 (4.3)	39.7 (5.8)	<0.001
<20	2,692 (0.2)	7 (0.0)	<0.001
20–29	262,966 (16.0)	2,531 (3.7)	
30–39	1,243,534 (75.7)	30,140 (44.4)	
≥40	134,679 (8.2)	35,165 (51.8)	
Maternal age (years)			
Mean	31.2 (3.9)	27.0 (5.4)	<0.001
<20	6,161 (0.4)	2,534 (3.7)	<0.001
20–34	1,377,225 (81.3)	58,547 (86.1)	
≥35	301,473 (18.3)	6,948 (10.2)	
Area of birth			
Metropolitan city	727,158 (44.2)	23,718 (34.9)	<0.001
Others	917,798 (55.8)	44,356 (65.1)	
Place of birth			
Hospital	1,618,945 (98.5)	67,032 (98.5)	0.078
Others	25,375 (1.5)	992 (1.5)	
Paternal education			
College or higher	1,195,763 (72.8)	22,404 (33.1)	<0.001
High school or lower	446,180 (27.2)	45,236 (66.9)	
Maternal education			
College or higher	1,183,744 (72.1)	17,887 (26.5)	<0.001
High school or lower	458,690 (27.9)	49,559 (73.5)	
Paternal employment			
Manager or specialist	461,544 (28.1)	10,562 (15.5)	<0.001
Officer	569,396 (34.6)	12,903 (19.0)	
Service	281,995 (17.1)	12,272 (18.0)	
Blue collar	271,138 (16.5)	28,455 (41.8)	
Unemployed [a]	60,883 (3.7)	3,882 (5.7)	
Maternal employment			
Manager or specialist	217,102 (13.2)	1,798 (2.7)	<0.001
Officer	242,314 (14.7)	1,382 (2.0)	
Service	75,747 (4.6)	1,034 (1.5)	
Blue	28,668 (1.7)	3,244 (4.8)	
Unemployed [a]	1,081,125 (65.8)	60,616 (89.0)	
Parity			
Primiparous	840,098 (51.1)	41,462 (61.0)	<0.001

Multiparous	803,834 (48.9)	26,547 (39.0)	
Maternal country			
High and upper-middle income	NA	25,780 (38.0)	-
Asia		23,511 (34.7)	
Europe		483 (0.7)	
America and Pacific region		1,786 (2.6)	
Africa		0 (0.0)	
Low and lower-middle income	NA	42,027 (62.0)	-
Asia		40,651 (60.0)	
Europe		1,369 (2.0)	
America and Pacific region		0 (0.0)	
Africa		7 (0.0)	

a. Unemployed: unemployed, housewife, or student

SD: standard deviation, NA: not applicable.

B. Correlations among variables

Among native women, mother's education level was moderately correlated with father's education level. Otherwise, other socioeconomic factors showed weak correlations among each other, and socioeconomic indices and adverse birth outcomes showed very weak correlations. Among immigrants, mother's education level was weakly correlated with father's education level and occupation, and paternal education level showed weak correlation with paternal occupation. As in the natives group, immigrants showed very weak correlation between socioeconomic factors and birth outcomes. In general, the size of values from Spearman rank coefficient tests were similar or smaller in the immigrants group, compared to natives group (Table 2).

Table 2. Correlations between socioeconomic factors and birth outcomes (Spearman rank coefficients), by maternal nationalities

	Preterm	LBW	SGA	Father's occupation	Mother's occupation	Father's education	Mother's education
Natives							
Preterm	1.0	0.481	.	0.013	0.012	0.026	0.030
LBW		1.0	0.424	0.011	0.008	0.023	0.025
SGA			1.0	0.005	0.003	0.009	0.008
Father's occupation				1.0	0.205	0.310	0.241
Mother's occupation					1.0	0.201	0.239
Father's education						1.0	0.495
Mother's education							1.0
Immigrants							
Preterm	1.0	0.432	.	0.002	0.002	0.003	0.004
LBW		1.0	0.438	0.014	0.007	0.012	0.009
SGA (term)			1.0	0.016	0.006	0.014	0.018
Father's occupation				1.0	0.065	0.337	0.264
Mother's occupation					1.0	0.124	0.146
Father's education						1.0	0.396
Mother's education							1.0

LBW: Low birth weight

SGA: Small for gestational age in term infants

C. Adverse birth outcomes among immigrant women in Korea

1) Preterm birth

The proportion of preterm birth in the immigrant group was higher than that in the native Korean group, although this difference was not statistically significant (4.7% vs. 4.6%, $P = 0.255$). After adjusting for the birth-related factors, the proportion of preterm birth remained significantly higher in the immigrant group (4.9% vs. 4.6%, $P < 0.001$). However, after adjusting for birth-related and socioeconomic factors, preterm birth was more prevalent in the native Korean group (4.6% vs. 4.0%, $P < 0.001$) (Table 3). In the subgroup analysis, the proportion of very preterm (<32 weeks) was significantly higher in the native Korean group (1.0% vs. 0.9%, p = 0.037).

2) Low birth weight

The proportion of low birth weight was significantly higher in the immigrant group (4.2% vs. 3.7%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (4.2% vs. 3.6%, $P < 0.001$). However, after adjusting for birth-related and socioeconomic factors, the proportion of low birth weight was significantly higher in the native Korean group (3.6% vs. 3.4%, $P = 0.003$) (Table 3). Subgroup analysis of the proportions of very low birth weight revealed that it was significantly more frequent in the native Korean group (0.4% vs. 0.3%, $P < 0.001$).

3) Small for gestational age in term infants

The proportion of SGA was significantly higher in the immigrant group (8.1% vs. 6.1%, $P < 0.001$), and similar results were observed after adjusting for birth-related factors and socioeconomic factors (Table 3).

Table 3. Analyses of the proportions of preterm birth, low birth weight, and small for gestational age (SGA) in term infants.

	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants (%)	*P*-value	Native Koreans (%)	Immigrants (%)	*P*-value	Native Koreans (%)	Immigrants (%)	*P*-value
Preterm birth	4.6	4.7	0.255	4.6	4.9	<0.001	4.6	4.0	<0.001
Low birth weight	3.7	4.2	<0.001	3.6	4.2	<0.001	3.6	3.4	0.003
SGA in term infants	6.1	8.1	<0.001	5.7	7.2	<0.001	5.7	6.4	<0.001

a. Adjusted for infant sex, maternal age, marriage status, and parity

b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

D. Subgroup analysis according to maternal original nationalities

1) Asia

(1) Preterm birth

The proportion of preterm birth in the immigrant women from Asian countries was not significantly different from the native group (4.8% vs. 4.7%, $P = 0.168$). After adjusting for the birth-related factors, the proportion of preterm birth was significantly higher in the immigrant group (4.9% vs. 4.6%, $P < 0.001$). However, after adjusting for birth-related and socioeconomic factors, preterm birth was more prevalent in the native Korean group (4.6% vs. 4.0%, $P < 0.001$) (Table 4).

(2) Low birth weight

The proportion of low birth weight was significantly higher in the immigrant group (4.3% vs. 3.7%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (4.2% vs. 3.6%, $P < 0.001$). However, after adjusting for birth-related and socioeconomic factors, the proportion of low birth weight was significantly higher in the native Korean group (3.6% vs. 3.4%, $P = 0.003$) (Table 4).

(3) Small for gestational age in term infants

The proportion of SGA was significantly higher in the immigrant group (8.2% vs. 6.1%, $P < 0.001$), and similar results were observed after adjusting for birth-related factors (7.2% vs. 5.7%, $P < 0.001$), and birth-related and socioeconomic factors (6.5% vs. 5.7%, $P < 0.001$) (Table 4).

Table 4. Analyses of adverse birth outcomes among Korean natives and immigrant women from Asia

	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants from Asia (%)	*P*-value	Native Koreans (%)	Immigrants from Asia (%)	*P*-value	Native Koreans (%)	Immigrants from Asia (%)	*P*-value
Preterm birth	4.7	4.8	0.168	4.6	4.9	<0.001	4.6	4.0	<0.001
Low birth weight	3.7	4.3	<0.001	3.6	4.2	<0.001	3.6	3.4	0.003
SGA in term infants	6.1	8.2	<0.001	5.7	7.2	<0.001	5.7	6.5	<0.001

a. Adjusted for infant sex, maternal age, marriage status, and parity

b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

SGA: Small for gestational age in term infants

2) China

(1) Preterm birth

The proportion of preterm birth in the immigrant women from China was significantly lower than that in the native Korean group (4.2% vs. 4.7%, $P = 0.004$). Even after adjusting for the birth-related factors (4.2% vs. 4.6%, $P = 0.008$) and both birth-related and socioeconomic factors (3.6% vs. 4.6%, $P < 0.001$), the proportion of preterm birth remained significantly lower in the immigrant group (Table 5).

(2) Low birth weight

The proportion of low birth weight was significantly lower in the Chinese group (3.0% vs. 3.7%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (2.8% vs. 3.6%, $P < 0.001$) and after adjusting for birth-related and socioeconomic factors (2.4% vs. 3.6%, $P < 0.001$) (Table 5).

(3) Small for gestational age in term infants

The proportion of low birth weight was significantly lower in the Chinese group (5.2% vs. 6.1%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (4.5% vs. 5.7%, $P < 0.001$) and after adjusting for birth-related and socioeconomic factors (4.1% vs. 5.7%, $P < 0.001$) (Table 5).

Table 5. Analyses of adverse birth outcomes among Korean natives and immigrant women from China

	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants from China (%)	*P*-value	Native Koreans (%)	Immigrants from China (%)	*P*-value	Native Koreans (%)	Immigrants from China (%)	*P*-value
Preterm birth	4.7	4.2	0.004	4.6	4.2	0.008	4.5	3.6	<0.001
Low birth weight	3.7	3.0	<0.001	3.6	2.8	<0.001	3.6	2.4	<0.001
SGA in term infants	6.1	5.2	<0.001	5.7	4.5	<0.001	5.7	4.1	<0.001

a. Adjusted for infant sex, maternal age, marriage status, and parity

b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

SGA: Small for gestational age in term infants

3) Southeast Asia

(1) Preterm birth

The proportion of preterm birth in the immigrant women from Southeast Asia was significantly higher than that in the native Korean group (5.1% vs. 4.7%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (5.4% vs. 4.6%, $P < 0.001$). However, after adjusting for birth-related and socioeconomic factors, preterm birth was more prevalent in the native Korean group (4.6% vs. 4.2%, $P < 0.001$) (Table 6).

(2) Low birth weight

The proportion of low birth weight was significantly higher in the immigrant group (4.8% vs. 3.7%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (4.9% vs. 3.6%, $P < 0.001$). The trend was similar though it was not significant when adjusted for birth-related and socioeconomic factors (3.7% vs. 3.6%, $P = 0.172$) (Table 6).

(3) Small for gestational age in term infants

The proportion of SGA was significantly higher in the immigrant group (9.3% vs. 6.1%, $P < 0.001$), and similar results were observed after adjusting for birth-related factors (8.3% vs. 5.7%, $P < 0.001$), and birth-related and socioeconomic factors (7.2% vs. 5.7%, $P < 0.001$) (Table 6).

Table 6. Analyses of adverse birth outcomes among Korean natives and immigrant women from Southeast Asia

	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants from SE Asia (%)	*P*-value	Native Koreans (%)	Immigrants from SE Asia (%)	*P*-value	Native Koreans (%)	Immigrants from SE Asia (%)	*P*-value
Preterm birth	4.7	5.1	<0.001	4.6	5.4	<0.001	4.6	4.2	<0.001
Low birth weight	3.7	4.8	<0.001	3.6	4.9	<0.001	3.6	3.7	0.172
SGA in term infants	6.1	9.3	<0.001	5.7	8.3	<0.001	5.7	7.2	<0.001

a. Adjusted for infant sex, maternal age, marriage status, and parity

b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

SGA: Small for gestational age, SE: Southeast

4) Europe

(1) Preterm birth

The proportion of preterm birth in the immigrant women from European countries was lower than the native group though it was not significant (4.3% vs. 4.7%, P = 0.503). The results showed similar trend after adjusting for the birth-related factors (4.4% vs. 4.6%, P = 0.655), and adjusting for birth-related and socioeconomic factors (4.0% vs. 4.5%, P = 0.229) (Table 7).

(2) Low birth weight

The proportion of low birth weight in the immigrants group was not significantly different from that of the natives group (3.7% vs. 3.7%, P = 0.987), and a similar result was observed after adjusting for birth-related factors (3.7% vs. 3.6%, P = 0.828), and after adjusting for birth-related and socioeconomic factors (3.4% vs. 3.6%, P = 0.638) (Table 7).

(3) Small for gestational age in term infants

The proportion of SGA in the immigrants group was not significantly different from that of the natives group (5.8% vs. 6.1%, P = 0.609), and a similar result was observed after adjusting for birth-related factors (5.4% vs. 5.7%, P = 0.617), and after adjusting for birth-related and socioeconomic factors (5.2% vs. 5.7%, P = 0.413) (Table 7).

Table 7. Analyses of adverse birth outcomes among Korean natives and immigrant women from Europe

	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants from Europe (%)	*P*-value	Native Koreans (%)	Immigrants from Europe (%)	*P*-value	Native Koreans (%)	Immigrants from Europe (%)	*P*-value
Preterm birth	4.7	4.3	0.503	4.6	4.4	0.655	4.5	4.0	0.229
Low birth weight	3.7	3.7	0.987	3.6	3.7	0.828	3.6	3.4	0.638
SGA in term infants	6.1	5.8	0.609	5.7	5.4	0.617	5.7	5.2	0.413

a. Adjusted for infant sex, maternal age, marriage status, and parity

b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

SGA: Small for gestational age in term infants

5) America

(1) Preterm birth

The proportion of preterm birth in the immigrant women from American countries was not significantly different, compared to the native group (4.6% vs. 4.7%, P = 0.881). The results were similar after adjusting for the birth-related factors (4.5% vs. 4.6%, P = 0.933), and adjusting for birth-related and socioeconomic factors (4.8 vs. 4.5%, P = 0.615) (Table 8).

(2) Low birth weight

The proportion of low birth weight in the immigrant women from American countries was not significantly different from that of the natives group (3.7% vs. 3.7%, P = 0.934), and a similar result was observed after adjusting for birth-related factors (3.5% vs. 3.6%, P = 0.715), and after adjusting for birth-related and socioeconomic factors (3.7% vs. 3.6%, P = 0.854) (Table 8).

(3) Small for gestational age in term infants

The proportion of SGA in the immigrants group was not significantly different from that of the natives group (5.9% vs. 6.1%, P = 0.685), and a similar result was observed after adjusting for birth-related factors (5.0% vs. 5.7%, P = 0.202), and after adjusting for birth-related and socioeconomic factors (5.2% vs. 5.7%, P = 0.368) (Table 8).

Table 8. Analyses of adverse birth outcomes among Korean natives and immigrant women from America

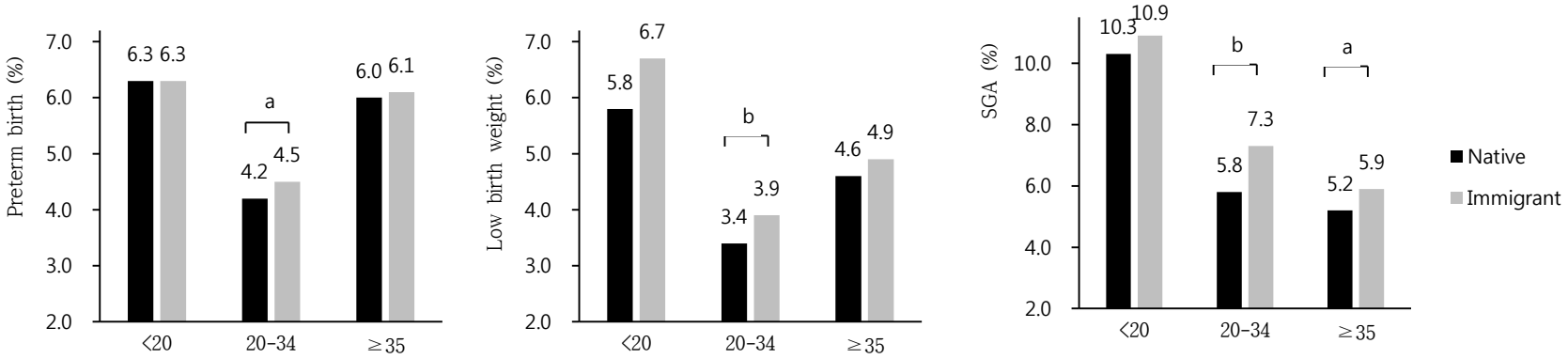
	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants from America (%)	*P*-value	Native Koreans (%)	Immigrants from America (%)	*P*-value	Native Koreans (%)	Immigrants from America (%)	*P*-value
Preterm birth	4.7	4.6	0.881	4.6	4.5	0.933	4.5	4.8	0.615
Low birth weight	3.7	3.7	0.934	3.6	3.5	0.715	3.6	3.7	0.854
SGA in term infants	6.1	5.9	0.685	5.7	5.0	0.202	5.7	5.2	0.368

a. Adjusted for infant sex, maternal age, marriage status, and parity
b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

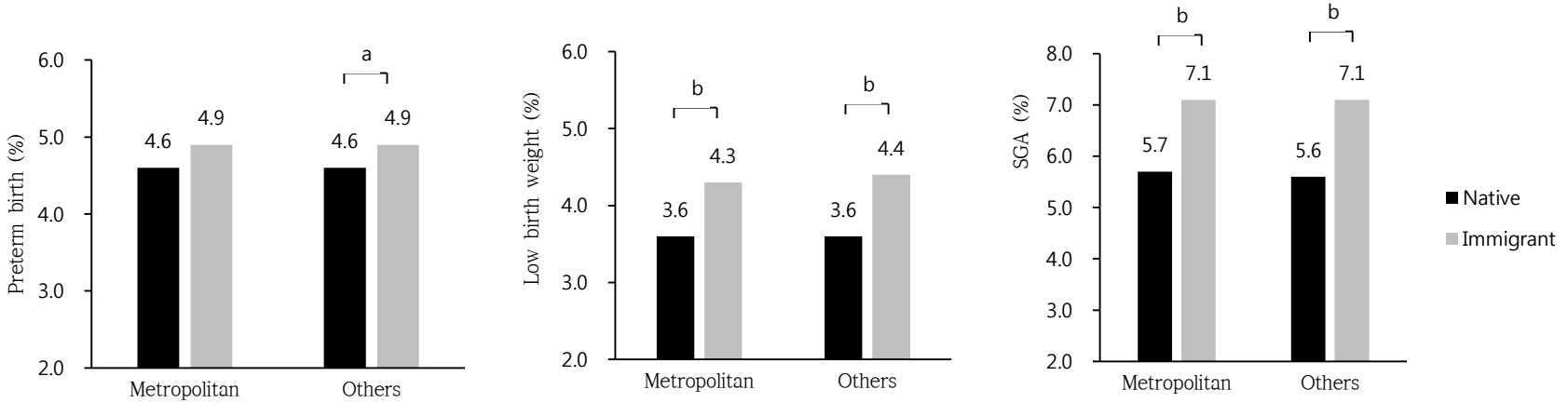
SGA: Small for gestational age in term infants

E. Subgroup analysis according to demographic characteristics

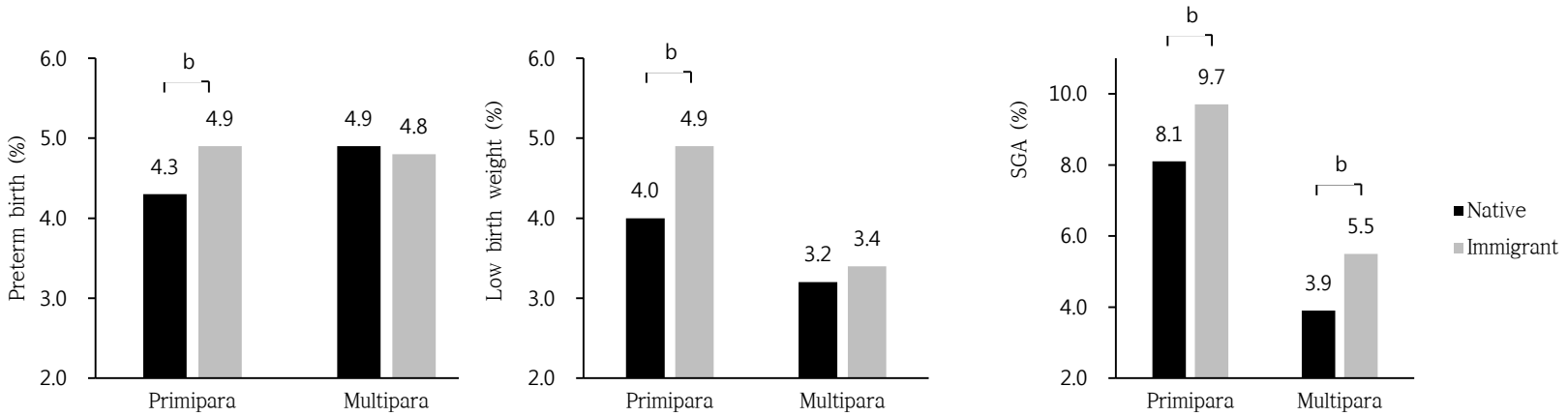
After adjusting for birth-related factors, the proportions of preterm birth and low birth weight were not significant different for women who were <20 years old or ≥35 years old. However, among women who were 20–34 years old, both proportions were significantly higher in the immigrant group (preterm birth: 4.5% vs. 4.2%, P = 0.003; low birth weight: 3.9% vs. 3.4%, P < 0.001). The proportions of SGA were significantly higher among women in the immigrant groups who were aged 20 and over. When the adjusted proportions of birth outcomes were compared according to region, the immigrant group had higher proportions of preterm birth, low birth weight, and SGA for both metropolitan cities and other areas. Analyses according to parity revealed that the proportions of preterm birth and low birth weight were higher in the primipara immigrant group (preterm birth: 4.9% vs. 4.3%, P < 0.001; low birth weight: 4.9% vs. 4.0%, P < 0.001), although there were no significant differences among multipara mothers (preterm birth: 4.8% vs. 4.9%, P = 0.370; low birth weight: 3.4% vs. 3.2%, P = 0.190). However, the proportions of SGA were significantly higher both in the primipara and multipara immigrant group (Fig. 2).



(a) Analysis according to maternal age



(b) Analysis according to area of birth

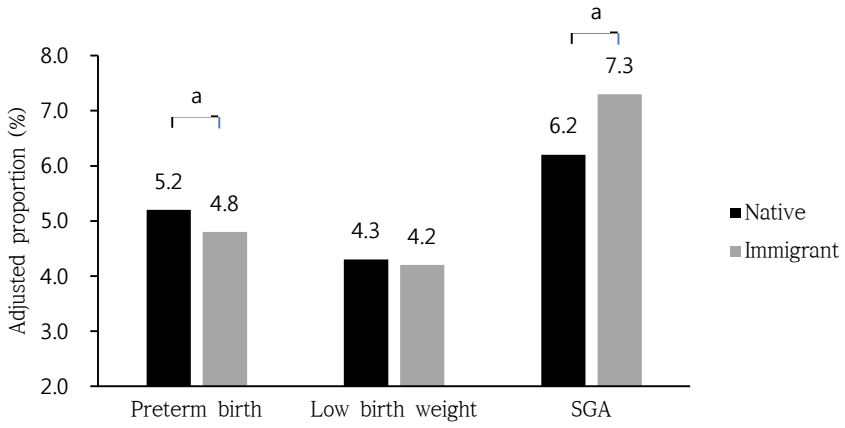


(C) Analysis according to parity

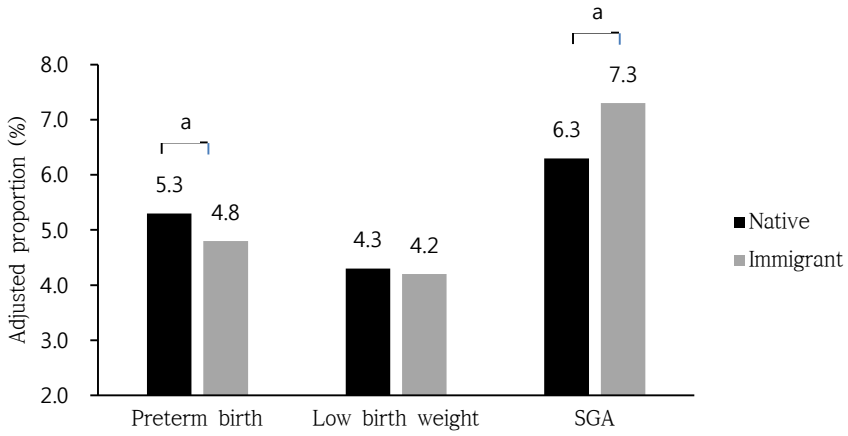
Fig. 2. Subgroup analyses of preterm births and low birth weight infants among immigrant and native women in Korea (adjusted for infant sex, maternal age, marriage status, and parity). a: $p < 0.05$, b: $p < 0.001$, SGA: small for gestational age in term infants

F. Comparing outcomes among vulnerable populations

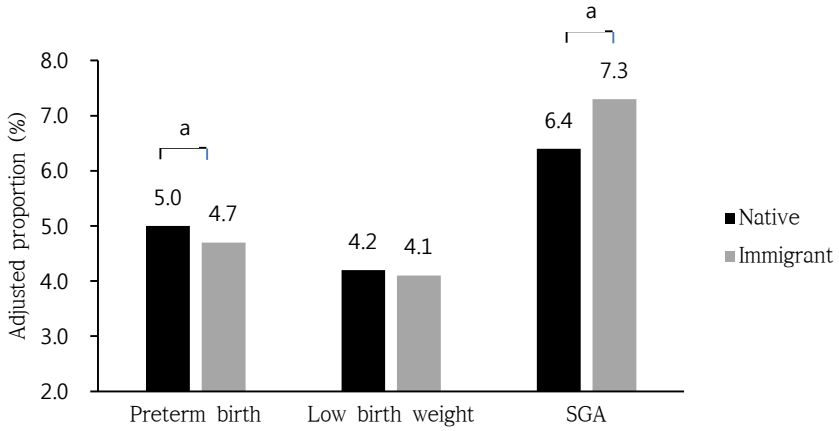
When the birth outcomes of immigrants and vulnerable native Koreans (low maternal or paternal education, or paternal unemployment) were compared, similar findings were observed for all three analyses. The proportions of preterm birth were higher among the vulnerable native Koreans, and the proportions of SGA were higher among the immigrant group, although the proportions of low birth weight were similar for immigrants and vulnerable native Koreans (Fig. 3). In subgroup analyses for immigrants from Southeast Asia, the results show that the proportion of preterm birth was not different but the proportions of low birth weight and SGA were significantly higher in the immigrant group for all three analyses (Fig. 4).



(a) Compared to less educated fathers in the native group



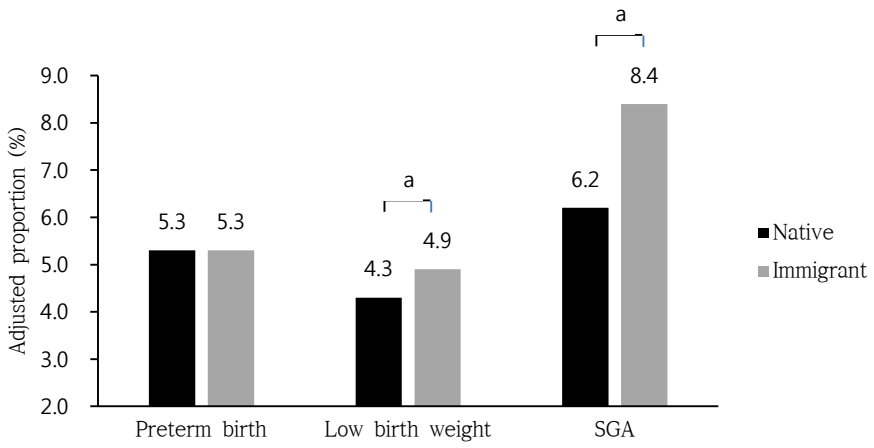
(b) Compared to less educated mothers in the native group



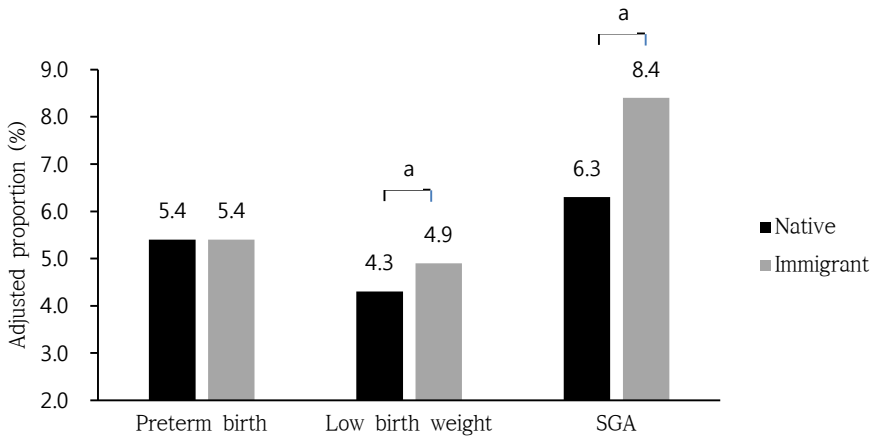
(c) Compared to unemployed fathers in the native group

Fig. 3. Adjusted proportion of adverse birth outcomes among immigrants and vulnerable native Koreans in Korea.

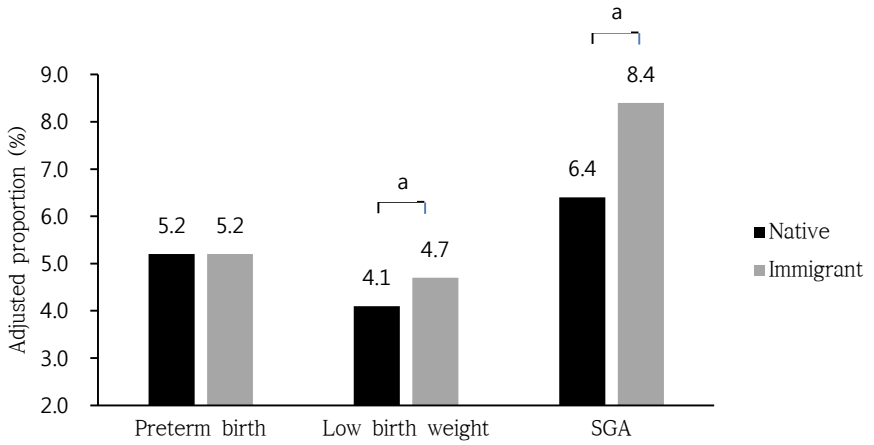
a: $p < 0.001$, SGA: small for gestational age in term infants



(a) Compared to less educated fathers in the native group



(b) Compared to less educated mothers in the native group



(c) Compared to unemployed fathers in the native group

Fig. 4. Adjusted proportion of adverse birth outcomes among immigrants from Southeast Asia and vulnerable native Koreans in Korea.

a: $p < 0.001$, , SGA: small for gestational age in term infants

G. Factors that were associated with adverse birth outcomes

1) Frequency of adverse birth outcome by individual-level characteristics

Table 9 shows crude data of proportion of adverse birth outcomes according to demographic factors. The proportions of preterm birth and SGA were higher in male than female. Preterm births were more frequently occurred among the native group in less educated parents, compared to the immigrant group, otherwise those were higher in the immigrants group in parents who graduated college or higher, compared to the native group. In contrast, among less educated parent, proportions of low birth weight and SGA were similar or higher in the immigrant group than the native group. Both native and immigrant group showed higher proportion of adverse birth outcomes from fathers who were blue-collar workers or unemployed, compared to other father's occupations. All adverse birth outcomes were more likely to occur from immigrant mothers who came from low and lower-middle countries.

Table 9. Frequency of adverse birth outcomes by individual-level characteristics in Korea, 2010-2013

	Preterm birth		Low birth weight		SGA	
	Natives n (%)	Immigrants n (%)	Natives n (%)	Immigrants n (%)	Natives n (%)	Immigrants n (%)
Infant sex						
Female	33,321 (4.1)	1,352 (4.1)	32,233 (4.0)	1,500 (4.5)	39,728 (5.1)	2,139 (6.7)
Male	43,140 (5.1)	1,876 (5.4)	28,424 (3.4)	1,367 (3.9)	55,895 (7.0)	3,099 (9.4)
Marital status						
Married	74,914 (4.6)	3,196 (4.7)	59,312 (3.7)	2,843 (4.2)	93,834 (6.1)	5,207 (8.1)
Unmarried	1,547 (7.2)	32 (7.5)	1,345 (6.2)	24 (5.6)	1,789 (8.9)	31 (7.8)
Paternal age (years)						
< 20	219 (8.1)	0 (0.0)	189 (7.0)	1 (14.3)	274 (11.1)	2 (28.5)
20 – 29	11,275 (4.3)	87 (3.4)	9,284 (3.5)	80 (3.2)	17,737 (7.1)	194 (7.9)
30 – 39	56,113 (4.5)	1,383 (4.6)	44,403 (3.6)	1,227 (4.1)	70,231 (5.9)	2,268 (7.9)
≥ 40	8,766 (6.5)	1,739 (5.0)	6,705 (5.0)	1,544 (4.4)	7,289 (5.8)	2,754 (8.2)
Maternal age (years)						
< 20	447 (7.3)	136 (5.4)	390 (6.3)	147 (5.8)	606 (10.6)	258 (10.8)
20 – 34	57,859 (4.3)	2,663 (4.6)	46,133 (3.5)	2,353 (4.0)	79,130 (6.2)	4,513 (8.1)
≥ 35	18,150 (6.0)	425 (6.1)	14,132 (4.7)	363 (5.2)	15,876 (5.6)	463 (7.1)
Parity						
Primiparous	36,634 (4.4)	1,983 (4.8)	34,215 (4.1)	1,989 (4.8)	65,589 (8.2)	3,839 (9.7)
Multiparous	39,757 (5.0)	1,241 (4.7)	26,396 (3.3)	874 (3.3)	29,948 (3.9)	1,394 (5.5)
Area of birth						
Metropolitan	33,667 (4.7)	1,124 (5.0)	26,972 (3.6)	1,025 (4.1)	42874 (6.2)	1,819 (8.1)
Others	42,804 (4.4)	2,104 (4.3)	33,685 (3.5)	1,842 (3.9)	52749 (6.0)	3,419 (8.1)
Place of birth						
Hospital	75,156 (4.6)	3,174 (4.7)	59,715 (3.7)	2,825 (4.2)	1,925 (8.0)	5,156 (8.1)
Others	1,271 (5.0)	51 (5.1)	919 (3.6)	41 (4.1)	93,663 (6.1)	78 (8.3)

a. Unemployed: unemployed, housewife, or student

SGA: small for gestational age in term infants

Table 9. Frequency of adverse birth outcomes by individual-level characteristics in Korea, 2010-2013 (continued)

	Preterm birth		Low birth weight		SGA	
	Natives n (%)	Immigrants n (%)	Natives n (%)	Immigrants n (%)	Natives n (%)	Immigrants n (%)
Paternal education						
High school or below	24,696 (5.5)	2,152 (4.8)	19,547 (4.4)	1,966 (4.4)	27,110 (6.4)	3,598 (8.4)
College or higher	51,577 (4.3)	1,049 (4.7)	40,958 (3.4)	879 (3.9)	68,308 (6.0)	1,606 (7.5)
Maternal education						
High school or below	25,843 (5.6)	2,319 (4.8)	20,334 (4.4)	2,110 (4.4)	27,686 (6.4)	3,870 (8.4)
College or higher	50,477 (4.3)	884 (4.7)	40,208 (3.4)	736 (3.9)	67,772 (6.0)	1,317 (7.3)
Paternal job						
Manager / specialist	20,351 (4.4)	508 (4.8)	16,105 (3.5)	414 (3.9)	26,351 (6.0)	745 (7.4)
Clerical worker	25,267 (4.4)	598 (4.6)	20,246 (3.6)	511 (4.0)	32,968 (6.1)	934 (7.6)
Service worker	13,590 (4.8)	561 (4.6)	10,651 (3.8)	475 (3.9)	16,443 (6.1)	938 (8.0)
Blue-collar	14,039 (5.2)	1,380 (4.9)	11,012 (4.1)	1,284 (4.5)	15,838 (6.2)	2,297 (8.5)
Unemployed [a]	3,214 (5.3)	181 (4.7)	2,643 (4.3)	183 (4.7)	4,023 (7.0)	324 (8.8)
Maternal job						
Manager / specialist	9,202 (4.2)	89 (5.0)	7,455 (3.4)	70 (3.9)	12,802 (6.2)	124 (7.3)
Clerical workers	10,202 (4.2)	66 (4.8)	8,377 (3.5)	40 (2.9)	14,505 (6.3)	78 (5.9)
Service workers	3,550 (4.7)	57 (5.5)	2,760 (3.6)	41 (4.0)	4,413 (6.1)	78 (8.0)
Blue-collar	1,402 (4.9)	127 (3.9)	1,045 (3.7)	133 (4.1)	1,709 (6.3)	267 (8.6)
Unemployed [a]	52,105 (4.8)	2,889 (4.8)	41,020 (3.8)	2,583 (4.3)	62,194 (6.0)	4,691 (8.1)
Maternal country						
High and upper-middle		1,110 (4.3)		848 (3.3)		1,533 (6.2)
Low and lower-middle		2,104 (5.0)		2,008 (4.8)		3,684 (9.2)

a. Unemployed: unemployed, housewife, or student

SGA: small for gestational age in term infants

2) Multivariate analysis for the immigrants group

Multivariate analyses revealed that male infants had a higher risk of preterm birth (OR: 1.36; 95% CI: 1.27–1.46), SGA (OR: 1.45; 95% CI: 1.37–1.54) and a lower risk of low birth weight (OR: 0.87; 95% CI: 0.80–0.94). Older maternal age (≥35 years) was a risk factor for preterm birth (OR: 1.49; 95% CI: 1.32–1.67), low birth weight (OR: 1.71; 95% CI: 1.50–1.93) and SGA (OR: 1.16; 95% CI: 1.04–1.29), and multipara women exhibited a 33% lower risk of low birth weight and a 46% lower risk of SGA, compared to primipara women. Immigrant women from low-/lower-middle-income countries had a 28% higher risk of preterm birth, a 60% higher risk of low birth weight and a 54% higher risk of SGA, compared to immigrants from high-/upper-middle-income countries. Parental education level or occupation did not affect the risks of preterm birth or low birth weight in the immigrant group (Table 10).

Table 10. Multivariate analysis for factors associated with adverse birth outcomes among immigrant women in Korea

	Preterm birth (aOR, 95% CI)	Low birth weight (aOR, 95% CI)	Small for gestational age (aOR, 95% CI)
Infant sex			
Female	1.0 (reference)	1.0 (reference)	1.0 (reference)
Male	1.36 (1.27-1.46)[b]	0.87 (0.80-0.94)[b]	1.45 (1.37-1.54)[b]
Marital status			
Married	1.0 (reference)	1.0 (reference)	1.0 (reference)
Unmarried	1.11 (0.57-2.19)	0.97 (0.45-2.09)	0.97 (0.76-1.23)
Paternal age (years)			
< 20	0	4.10 (0.47-35.44)	4.92 (0.93-26.22)
20 - 29	0.81 (0.65-1.02)	0.87 (0.69-1.10)	1.05 (0.90-1.23)
30 - 39	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 40	1.03 (0.95-1.11)	0.98 (0.91-1.07)	0.98 (0.92-1.05)
Maternal age (years)			
< 20	1.08 (0.90-1.30)	1.13 (0.95-1.35)	0.99 (0.86-1.13)
20 - 34	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 35	1.49 (1.32-1.67)[b]	1.71 (1.50-1.93)[b]	1.16 (1.04-1.29)[a]
Parity			
Primiparous	1.0 (reference)	1.0 (reference)	1.0 (reference)
Multiparous	0.96 (0.89-1.03)	0.67 (0.61-0.72)[b]	0.54 (0.51-0.58)[b]
Area of birth			
Metropolitan	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	1.00 (0.93-1.08)	0.94 (0.87-1.02)	0.97 (0.92-1.04)
Place of birth			
Hospital	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.96 (0.71-1.28)	1.05 (0.76-1.45)	0.97 (0.76-1.23)
Paternal education			
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	1.04 (0.95-1.14)	1.01 (0.92-1.11)	0.99 (0.93-1.07)
Maternal education			
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	1.02 (0.93-1.12)	1.04 (0.94-1.15)	1.01 (0.93-1.09)
Paternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	0.97 (0.86-1.10)	1.04 (0.91-1.19)	1.04 (0.94-1.15)
Service worker	0.94 (0.83-1.10)	0.95 (0.83-1.10)	1.04 (0.94-1.16)
Blue-collar	1.00 (0.89-1.12)	1.09 (0.96-1.24)	1.08 (0.98-1.18)
Unemployed [c]	0.97 (0.81-1.16)	1.16 (0.97-1.40)	1.12 (0.97-1.29)
Maternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	1.03 (0.74-1.45)	0.74 (0.49-1.11)	0.76 (0.56-1.03)
Service workers	1.12 (0.79-1.61)	1.02 (0.68-1.53)	0.97 (0.71-1.31)
Blue-collar	0.72 (0.53-0.97)[a]	0.88 (0.64-1.21)	0.98 (0.77-1.25)
Unemployed [c]	0.93 (0.74-1.17)	0.95 (0.73-1.23)	0.91 (0.74-1.10)
Maternal country			
High and upper-middle income	1.0 (reference)	1.0 (reference)	1.0 (reference)
Low and lower-middle income	1.28 (1.17-1.40)[b]	1.60 (1.45-1.76)[b]	1.54 (1.43-1.66)[b]

a. $p < 0.05$, b. $p < 0.001$, c. Unemployed: unemployed, housewife, or student

3) Multivariate analysis for the natives group

Multivariate analyses revealed that male infants had a higher risk of preterm birth (OR: 1.26; 95% CI: 1.24–1.28) and SGA (OR: 1.40; 95% CI: 1.38-1.42), and a lower risk of low birth weight (OR: 0.84; 95% CI: 0.83–0.86). Infants in unmarried couples had higher risks of preterm birth (OR: 1.33; 95% CI: 1.26-1.41), low birth weight (OR: 1.37; 95% CI: 1.29-1.45) and SGA (OR: 1.17; 95% CI: 1.11-1.24). Younger paternal age (<20 years) was a risk factor for preterm birth (OR: 1.21; 95% CI: 1.01-1.44), but it was not a risk factor for low birth weight and SGA. Paternal age from 20 to 29 had lower risk of all adverse birth outcomes while aged 40 and over had higher risks, compared to age from 30 to 39. Both younger (<20 years) and older maternal age (≥35 years) were risk factors for preterm birth, low birth weight and SGA. Multipara women exhibited a 5% higher risk of preterm birth, and a 28% and a 56% lower risk of low birth weight and SGA, compared to primipara women. Babies who were born in other places than hospitals had higher risk of low birth weight (OR: 1.08; 95% CI: 1.01-1.15) and lower risk of SGA (OR: 0.73; 95% CI: 0.70-0.77). Parents with higher educational level (college or higher) had lower risks of preterm birth, low birth weight and SGA. Blue-collar worker fathers had a 7% higher risk of preterm birth and a 8% higher risk of low birth weight, and unemployed fathers had a 10% higher risk of preterm birth, a 13% of low birth weight and a 9% of SGA. Unemployed mothers had a 4% higher risk of low birth weight and SGA but blue-collar worker mothers had a 9% lower risk of low birth weight (Table 11).

Table 11. Multivariate analysis for factors associated with adverse birth outcomes among native women in Korea

	Preterm birth (aOR, 95% CI)	Low birth weight (aOR, 95% CI)	Small for gestational age (aOR, 95% CI)
Infant sex			
Female	1.0 (reference)	1.0 (reference)	1.0 (reference)
Male	1.26 (1.24-1.28)[b]	0.84 (0.83-0.86)[b]	1.40 (1.38-1.42)[b]
Marital status			
Married	1.0 (reference)	1.0 (reference)	1.0 (reference)
Unmarried	1.33 (1.26-1.41)[b]	1.37 (1.29-1.45)[b]	1.17 (1.11-1.24)[b]
Paternal age (years)			
< 20	1.14 (0.96-1.34)	1.02 (0.85-1.24)	1.02 (0.88-1.19)
20 - 29	0.95 (0.93-0.97)[b]	0.90 (0.88-0.93)[b]	0.98 (0.96-1.00)
30 - 39	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 40	1.20 (1.17-1.23)[b]	1.19 (1.15-1.23)[b]	1.06 (1.04-1.10)[b]
Maternal age (years)			
< 20	1.17 (1.03-1.33)[a]	1.15 (1.01-1.32)[a]	1.12 (1.01-1.25)[a]
20 - 34	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 35	1.27 (1.25-1.30)[b]	1.35 (1.32-1.38)[b]	1.06 (1.04-1.09)[b]
Parity			
Primiparous	1.0 (reference)	1.0 (reference)	1.0 (reference)
Multiparous	1.05 (1.03-1.07)[b]	0.72 (0.71-0.73)[b]	0.44 (0.44-0.45)[b]
Area of birth			
Metropolitan	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.98 (0.97-1.00)	0.98 (0.97-1.00)	1.0 (0.98-1.01)
Place of birth			
Hospital	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.97 (0.91-1.02)	1.08 (1.01-1.15)[a]	0.73 (0.70-0.77)[b]
Paternal education			
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	0.88 (0.87-0.89)[b]	0.87 (0.85-0.89)[b]	0.94 (0.92-0.95)[b]
Maternal education			
High school and below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	0.84 (0.82-0.85)[b]	0.83 (0.81-0.84)[b]	0.91 (0.89-0.92)[b]
Paternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	1.01 (0.99-1.03)	1.03 (1.01-1.05)[a]	1.02 (1.00-1.04)[a]
Service worker	1.01 (0.99-1.04)	1.01 (0.98-1.04)	1.01 (0.98-1.03)
Blue-collar	1.07 (1.05-1.10)[b]	1.08 (1.05-1.11)[b]	1.01 (0.99-1.04)
Unemployed [c]	1.10 (1.07-1.14)[b]	1.13 (1.08-1.18)[b]	1.09 (1.05-1.13)[b]
Maternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	0.98 (0.95-1.01)	0.98 (0.95-1.02)	1.00 (0.97-1.03)
Service workers	1.02 (0.98-1.06)	0.98 (0.93-1.02)	0.97 (0.93-1.00)
Blue-collar	0.97 (0.92-1.03)	0.91 (0.85-0.98)[a]	1.00 (0.95-1.06)
Unemployed [c]	1.02 (1.00-1.05)	1.04 (1.01-1.06)[a]	1.04 (1.02-1.06)[b]

a. $p < 0.05$

b. $p < 0.001$

c. Unemployed: unemployed, housewife, or student

4) Multivariate analysis for all births

Table 12 shows multivariate logistic regression for all births in Korea during 2010 to 2013. After adjustment with whole factors, immigrant women, regardless of economic status of their homeland, had lower risks of preterm birth and low birth weight. Immigrants from high and upper-middle income countries had a 9% lower risk of SGA while those from low and lower-middle income countries had a 28% higher risk of SGA. And the results revealed that male infants had a higher risk of preterm birth (OR: 1.26; 95% CI: 1.24–1.28) and SGA (OR: 1.40; 95% CI: 1.38-1.42), and a lower risk of low birth weight (OR: 0.84; 95% CI: 0.83–0.86). Infants in unmarried couples had higher risks of three of the adverse birth outcomes. Younger paternal age (<20 years) was a risk factor for preterm birth (OR: 1.21; 95% CI: 1.03-1.43), but it was not a risk factor for low birth weight and SGA. Paternal age from 20 to 29 had lower risk of preterm birth, low birth weight and SGA while aged 40 and over had higher risk of preterm birth, low birth weight and SGA, compared to age from 30 to 39. Both younger (<20 years) and older maternal age (≥35 years) were risk factors for adverse birth outcomes. Multipara women exhibited a 5% higher risk of preterm birth, a 28% lower risk of low birth weight and a 55% lower risk of SGA, compared to primipara women. Babies who were born in other places than hospitals had higher risk of low birth weight (OR: 1.07; 95% CI: 1.01-1.15) and lower risk of SGA (OR: 0.74; 95% CI: 0.71-0.78). Parents with higher educational level (college or higher) had lower risks of adverse birth outcomes, compared to less educated parents (high school or below). Blue-collar worker fathers had a 7% higher risk of preterm birth and a 8% higher risk of low birth weight, and unemployed fathers had a 9% higher risk of preterm birth, a 13% of low birth weight and a 10% of SGA. Unemployed mothers had a 4% higher risk of low birth weight and SGA (Table 12).

Table 12. Multivariate analysis for factors associated with adverse birth outcomes infants in Korea

	Preterm birth (aOR, 95% CI)	Low birth weight (aOR, 95% CI)	Small for gestational age (aOR, 95% CI)
Maternal country			
Natives	1.0 (reference)	1.0 (reference)	1.0 (reference)
High and upper-middle	0.81 (0.76-0.86)[b]	0.75 (0.70-0.80)[b]	0.91 (0.86-0.96)[b]
Low and lower-middle	0.86 (0.81-0.90)[b]	0.99 (0.94-1.04)	1.28 (1.23-1.33)[b]
Infant sex			
Female	1.0 (reference)	1.0 (reference)	1.0 (reference)
Male	1.26 (1.24-1.28)[b]	0.84 (0.83-0.86)[b]	1.40 (1.38-1.42)[b]
Marital status			
Married	1.0 (reference)	1.0 (reference)	1.0 (reference)
Unmarried	1.34 (1.26-1.42)[b]	1.36 (1.28-1.45)[b]	1.17 (1.11-1.24)[b]
Paternal age (years)			
< 20	1.15 (0.98-1.36)	1.03 (0.87-1.23)	1.05 (0.91-1.22)
20 - 29	0.95 (0.93-0.97)[b]	0.90 (0.88-0.93)[b]	0.98 (0.96-1.00)[a]
30 - 39	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 40	1.17 (1.15-1.20)[b]	1.16 (1.13-1.19)[b]	1.07 (1.04-1.10)[b]
Maternal age (years)			
< 20	1.17 (1.05-1.30)[a]	1.19 (1.07-1.33)[a]	1.10 (1.01-1.19)[a]
20 - 34	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 35	1.29 (1.26-1.31)[b]	1.36 (1.33-1.39)[b]	1.06 (1.04-1.08)[b]
Parity			
Primiparous	1.0 (reference)	1.0 (reference)	1.0 (reference)
Multiparous	1.05 (1.03-1.06)[b]	0.72 (0.71-0.73)[b]	0.45 (0.44-0.45)[b]
Area of birth			
Metropolitan	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.98 (0.97-1.00)	0.98 (0.97-1.00)	1.00 (0.98-1.01)
Place of birth			
Hospital	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.97 (0.91-1.02)	1.07 (1.01-1.15)[a]	0.74 (0.71-0.78)[b]
Paternal education			
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	0.89 (0.87-0.90)[b]	0.87 (0.86-0.89)[b]	0.94 (0.92-0.95)[b]
Maternal education			
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	0.84 (0.83-0.86)[b]	0.83 (0.81-0.85)[b]	0.91 (0.89-0.92)[b]
Paternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical worker	1.01 (0.99-1.03)	1.03 (1.01-1.05)[a]	1.02 (1.00-1.04)[a]
Service worker	1.01 (0.99-1.04)	1.01 (0.98-1.03)	1.01 (0.99-1.03)
Blue-collar	1.07 (1.04-1.09)[b]	1.08 (1.05-1.11)[b]	1.02 (1.00-1.04)
Unemployed [c]	1.09 (1.05-1.14)[b]	1.13 (1.08-1.18)[b]	1.10 (1.06-1.13)[b]
Maternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	0.98 (0.95-1.01)	0.98 (0.95-1.01)	1.00 (0.97-1.02)
Service workers	1.02 (0.98-1.07)	0.98 (0.94-1.03)	0.97 (0.93-1.00)
Blue-collar	0.96 (0.92-1.01)	0.92 (0.86-0.98)[a]	1.02 (0.96-1.07)
Unemployed [c]	1.02 (1.00-1.05)	1.04 (1.01-1.06)[a]	1.04 (1.02-1.06)[b]

a. $p < 0.05$, b. $p < 0.001$, c. Unemployed: unemployed, housewife, or student

V. Discussion and Conclusion

This report aimed to describe the proportions of preterm birth, low birth weight and SGA among immigrant women in Korea, and to compare these outcomes to those among native Korean women, in order to evaluate the disparities in perinatal health among immigrant and native women.

A. Demographic characteristics of the study population

These demographic data revealed that, compared to the native Korean group, the immigrant group had an older mean paternal age and a younger mean maternal age. Moreover, the immigrant group had a lower parental education level and a higher proportion of blue-collar workers. Given the rapid economic growth in Korea, rapid urbanization has led young women to frequently move to cities for better education and job opportunities. However, men in rural areas typically stay on family-owned farms, and this phenomenon makes it difficult for rural men to find marriage partners. Therefore, rural men have started looking to other countries for these partners, which led to the rate of international marriage increasing by approximately ten-fold since 1990; these marriages accounted for approximately 10% of all marriages in 2010 (Kim, 2009; Lee et al., 2012). These factors likely explain the findings that immigrant women were married to older men who were less education and more likely to be more blue-collar workers.

B. Correlation among variables

According to correlation tests, socioeconomic factors showed very weak correlation with adverse birth outcomes. These birth outcomes are known to be increased with socioeconomic disadvantages but it is often steepest at the lowest level of the social

grade rather than linear correlation (Kramer et al., 2000). Furthermore, previous studies reported selection bias in immigrant group that usually less educated people immigrate, thus this homogeneity lessening the educational gradient in health (Auger et al. 2008; Janevic et al. 2001). For this reason, these variables showed very weak correlation even though some variables had higher risks of adverse birth outcomes. Absolute values of correlation test between socioeconomic factors in the immigrant group were smaller than those of the native group. According to the previous studies, most immigrant women migrated to Korea for economic problems and became housewives. Therefore, 47% of them were unemployment state (mostly, housewives) and even 89% of immigrant women were unemployed in this study. Among employed immigrant women, 54.4% were blue-collar workers and their jobs were not related to their educational level. Janevic et al. explained this phenomenon as 'occupational downgrading' that immigrants have limited chance to get job compared to native-born with the same educational level and suffer from a loss of social status (Janevic et al., 2011). Furthermore, most immigrant women, especially from Vietnam, chose their spouse through marriage brokers and 67.2% are blue-collar workers (Kim, 2011; Korean Women's Development Institute, 2013). For these reasons, correlation between socioeconomic factors in the immigrant group may be weaker than the native group.

C. Adverse birth outcomes among immigrant women in Korea

After adjusting for birth-related factors (model 2), the proportions of preterm birth, low birth weight and SGA were noticeably higher in the immigrant group. In this context, most mothers in the immigrant group were from Asian countries, and previous studies have suggested that Asian mothers experience adverse birth outcomes relatively frequently (Gagnon et al., 2009; Urquia et al., 2015). In addition,

many of these mothers are from low socioeconomic groups in low-/low-middle-income countries (Ryu & Kim, 2013). These factors might affect the mothers' pre-pregnancy health and lead to them being underweight or having poor food intake, which might result in poor birth outcomes (Kim, 2009; Kliegman, 2012; Martin et al., 2014). However, after adjusting for socioeconomic factors (model 3; parental occupation, education level, and birth region), the proportions of preterm birth and low birth weight were higher in the native Korean group. This finding might indicate that these socioeconomic factors affected the higher proportions of adverse birth outcomes in the immigrant group that were observed in model 2 (Table 3) as previous studies (Parker, Schoendorf, & Kiely, 1994; Shin et al., 2012; Hanke et al. 2001). This finding also can be interpreted into the healthy migrant effect may apply to immigrant women in Korea. In the immigrant group, marriage based immigrant women comprise a large proportion thus they might be young and healthy enough to be chosen by their Korean spouses. For this reason, after adjusting socioeconomic effect, the birth outcomes were better or similar in the immigrant group, compared to the natives. Through these two results, health status of immigrant women can be interpreted in opposite way, however, it was impossible to know health status of immigrant women in this study, further researches are needed.

Interestingly, the proportion of SGA was higher in the immigrant group (Table 3). Higher SGA rates in immigrant group have been reported in the previous studies, such as among Blacks in the US, aborigines in Australia, Asians in the United Kingdom (Kramer, 2000). SGA may be a normal fetal response to lack of nutrition or oxygen in uterus. Not only fetal factors (e.g., chromosomal disorders, infections, etc.), but also maternal conditions (e.g., malnutrition, chronic illness, sickle cell anemia, etc.) can be associated with SGA (Kliegman, 2012). In this study, unlike preterm birth and low birth weight, the proportion of SGA was higher in the

immigrant group even after adjusting for socioeconomic factors, albeit the absolute values were decreased. This means that not only socioeconomic factors, but also health status of mothers may affect higher proportion of SGA. Racial or constitutional difference in birth weight is known to affect SGA (Kramer, 2000). However, as the international standard growth chart, the Fenton growth chart, was used to determine the percentile of birth weight, racial or constitutional differences were not reflected in this study. And maternal weight gain during pregnancy, one of the most important factor for SGA was not assessed. Therefore, there are limitations to estimate the reason of this result. However, SGA is known to be important cause of chronic diseases in adults, such as coronary heart disease, stroke, diabetes and hypertension. Therefore, it is important to evaluate mother's health status and follow up SGA babies for preventing chronic diseases (Barker, 1998).

In the subgroup analyses, the proportions of very preterm (gestational age <32 weeks) and very low birth weight (birth weight <1,500 g) were higher in the native group. To clarify the meaning of these results, we need more information regarding maternal perinatal history, such as the use of assisted reproductive technology or presence of maternal conditions (e.g., preeclampsia or chorioamnionitis) (Martin et al., 2014; Schieve et al., 2002; Wang et al., 2005).

In the subgroup analyses according to maternal original nationalities, the results were similar with previous studies that immigrants from Asian countries have tendency to show adverse birth outcomes (Gagnon et al., 2009; Urquia et al., 2015). Nevertheless, the results were quite different according to countries in Asia. In Table 5, immigrant women from China showed more favorable birth outcomes, compared to native women. In this study, immigrants from China accounted for 26.4% in the immigrant group, and according to a report about marriage based immigrant women in Korea,

Korean Chinese constituted approximately 60% in Chinese immigrants in Korea (Korean Women's Develoment Institute, 2013). They are known to have less language problems and more knowledge in Korean culture, and lower barriers to approach social welfare system (Choi, 2007). This might influence their settlement in Korean society and using health care system, and it might affect their favorable birth outcomes. Immigrant women from Southeast Asia showed tendency to have less favorable birth outcomes, compared to the native women (Table 6). Women from Southeast Asia accounted for 61.1% in the immigrant group and most of the countries are low- or low-middle income countries, and 86.5% of them graduated high school or below. Therefore, they might have poor pre-pregnant health condition, and many language challenges that could affect birth outcomes. Also, genetic factors and ethnic differences may cause these outcomes (Kramer, 1987; Urquia et al., 2015). On the other hand, immigrant women from Europe or America showed similar birth outcomes, compared to Korean native women (Table 7, 8). Even 73.9% of European came from low- or low-middle income countries and 47.4% of them are less educated, their birth outcomes were comparable to those in the native group. Genetic and ethnic factors can be reasons of these results though it was difficult to explain in this study. Approximately 77% of immigrants from America, their spouses were manager, specialists, or officers, on the contrary, only 32% for Asian immigrants (data were not shown). These differences in occupation might affect economic status of the immigrant group and result favorable birth outcomes.

Differences in birth outcomes between immigrant and native group were especially pronounced among women who were primipara or 20–35 years old. In the present study, the mean period from marriage to the first birth was 1.1 years in the immigrant group (data not shown), which indicates that immigrant women might not have had sufficient time to adjust to Korean society before their first pregnancy.

Furthermore, these women might experience language challenges, have low health literacy, and have low social status, which might affect their ability to obtain perinatal healthcare. In contrast, the birth outcomes among multipara women were comparable in the immigrant and native Korean groups, which might indicate that a longer duration of residency in Korea improved birth outcomes in the immigrant group. However, the proportion of SGA was significantly higher in the immigrant group among multipara women, and it may be affected by racial or constitutional differences.

D. Comparing the vulnerable immigrant and native Korean groups

When birth outcomes in the immigrant group and the vulnerable native Korean group (low education level or unemployed status) were compared, the native Korean group exhibited higher proportions of preterm birth. One of possible reasons that should be considered is relatively higher social support for immigrants compared to the vulnerable native groups. Immigrant women are categorized as vulnerable group in Korea and have better defined boundary than the disadvantaged native group. Therefore, it might be easy to apply support policies for local governments or non-governmental organizations for them, compared to less educated or unemployed natives. Previous studies also explained better birth outcomes of immigrants with greater levels of social supports that buffer the harmful effects of low socioeconomic status of immigrants (Auger et al., 2008; Janevic et al., 2011). The healthy migrant effect can be other reason of these results. Because, especially in the less educated group, the effect is more prominent than in the advantaged group (Auger et al., 2008). These results indicate that policies should embrace all disadvantaged groups, in order to provide equal access to qualified perinatal healthcare and to prevent adverse birth outcomes. Furthermore, to reduce the incidence of preterm birth and

low birth weight, women should quit smoking, avoid alcohol, consume a healthy diet, and regularly obtained prenatal care (Alexander & Korenbrot, 1995; Centers for Disease Control and Prevention, 2015). In 1974, the American government initiated a special supplemental nutrition program for women, infants, and children, which provides supplemental food, healthcare referrals, nutrition education, and breastfeeding promotion to women with low incomes, infants, or children who may have a high risk of poor nutrition. To accommodate immigrant families, information regarding this program is provided in nine languages. Prenatal participation in the program was positively associated with gestational age and mean birth weight, and was negatively associated with the incidence of low birth weight (the United States Department of Agriculture, 2015). In addition, some American states have implemented a 'Nurse-Family Partnership' program, in which registered nurses visit low-income and first-time mothers' homes 64 times during their pregnancy and until the child reaches the age of 2 years. The nurses provide preventive healthcare, prenatal practice, health and development education, and life coaching, and this program has been estimated to reduce the rates of smoking during pregnancy and preterm births, and to increase birth weight and the use of formal community health services (Olds, 2006). The British government also introduction a similar program in 2007, which was provided to first-time mothers who were <19 years old (Department of Health, 2015). In 2005, the Korean government developed 'Nutriplus program' for low-income families, which provides nutritional education, supplemental foods, and regular nutrition check-ups. However, the effectiveness of this program has not been evaluated, and there are few polices that support pregnant women in disadvantaged groups (Ministry of Health and Wealth, 2015). Therefore, it appears appropriate to evaluate the existing Korean policies and establish new policies, such

as home-nursing care, in order to support women who had a low socioeconomic status and/or are immigrants.

E. Multivariate analyses of factors that were associated with birth outcomes.

The multivariate analyses among the immigrant group (Table 10) revealed that male sex was associated with a higher risk of preterm birth and a lower risk of low birth weight, and previous studies have reported similar outcomes. Differences in the infant's sex may affect the uterine environment and result in preterm birth, and there are sex-specific differences in fetal fat sensitivities to hormones and the production of testosterone, which may result in male infants being heavier at birth (Di Renzo et al., 2007; Zeitlin et al., 2002). However, this theory remains debatable, and other studies have concluded that the infant's sex did not affect preterm birth and birth weight (Kramer, 1987), and a risk of SGA was higher in male infants. Immigrant mothers who were ≥35 years old had higher risks of adverse birth outcomes. These results are consistent with the findings of previous studies, and indicate that routine antenatal surveillance is needed for this age group (Cleary-Goldman et al., 2005; Hansen et al., 2012; Kramer, 1987). Risks of these outcomes were not decreased according to whether they gave birth in metropolitan cities or not. Therefore, support policies should be nationalized rather than concentrated on specific area. Contrary to the native group, risks were not significantly differed according to parent's educational level or occupations. Primipara women had a higher risk of low birth weight and SGA, and women from low-/lower-middle-income countries had higher risks of preterm birth and low birth weight. These results show that health status may affect birth outcomes more than socioeconomic status in

Korea. Especially, the mother's pre-immigration and early post-immigration statuses (health status, social support) may affect birth outcomes and more researches are needed.

Factors that may be associated with birth outcomes among native women are shown in Table 10 and the results were consistent with previous studies that explained above (Astolfi et al., 2006; Cleary-Goldman et al., 2005; Kramer, 1987; Shin et al., 2012). The results in multivariate analysis for all births in Korea revealed that immigrant women had lower risks for preterm birth and low birth weight. Even though the proportions of preterm birth and low birth weight were higher in the immigrant group before adjustment or in the limited adjustment, the results were opposite after adjusting for all factors. This means that these demographic and socioeconomic factors may affect the gap of birth outcomes between two groups. These results were corresponded to the results of adjusted proportion in this study and the results of previous studies, and we cannot exclude possibility of healthy migrant effect, therefore further researches for health status of immigrant women are needed (Frank & Hummer, 2002; Gagnon et al., 2009; Guendelman et al., 1999; Tsimbos & Verropoulou, 2011). Otherwise, risk of SGA was highest in immigrants from low and lower-middle income countries and racial or constitutional characters may affect this. Identifying reason of high risk of SGA in this group and following up for long term outcomes of SGA are needed.

F. Limitations and implications

There are several limitations that should be considered when interpreting these findings. First, data from a mandatory birth registry were used, although it does not contain all relevant maternal and infant data. For example, additional information

regarding maternal health (pre-pregnancy body mass index, hemoglobin levels during pregnancy, blood pressure, presence of sexual transmitted disease, and smoking) and infant health (congenital disease, intrauterine infection, and chromosomal disorders) might allow for a more precise assessment of the effects of socioeconomic factors and physical conditions (Goldenberg et al., 2008; Kramer, 1987). Second, as birth registry is not allowed for illegal immigrants, so birth outcome of illegal immigrant group were not assessed. There are approximately 200,000 illegal immigrants in Korea in 2014 and it is difficulty to access Korean health care system for them (Statistics Korea, 2015). Therefore, there might be problems in perinatal health care in this group and researches are needed for this group. To do that, making policies for official registry system for infants from illegal immigrants is necessary. Third, information regarding socioeconomic status was limited to education and occupation, and additional information regarding financial status and possessions might be used for more precise socioeconomic classifications (Caro & Cortés, 2012; Tello et al., 2005), which would provide additional data to support further policy improvements. Fourth, data regarding other birth outcomes, such as stillbirth, miscarriage, or infant mortality, were not accessible. These data would be important for assessing the perinatal environment and developing integrated policies that address the entire perinatal period. Fifth, data regarding the durations of the immigrant mothers' residency in Korea were not accessible, although primipara immigrant women are speculated to have shorter durations than multipara women. If data regarding residency durations were accessible, it would be possible to classify immigrants using this data, and to provide more appropriate support based on their characteristics and needs. Therefore, a more detailed birth registry is needed to provide additional information regarding infants with preterm birth and/or low birth weight. For example, the Korea National Research Institution of Health and The Korean Society of

Neonatology established a national prospective registry of very low birth weight infants (birth weight <1,500 g) in 2013 (Chang, Ahn, & Park, 2013), although that registry contains very little data, and is limited to very low birth weight infants. Thus, government support in modifying and expanding that registry to incorporate information regarding cases of low birth weight or preterm birth is recommended, which would provide the relevant data for more detailed assessments of at-risk groups and adverse birth outcomes.

Despite these limitations, this study also has several strengths. First, this is the first study to evaluate and compare the birth outcomes among immigrant and native women in Korea, and there are no other data that can be used to evaluate the policies that have been developed to support immigrant women and achieve positive birth outcomes. These findings revealed a high risk of preterm birth, low birth weight and SGA among immigrant women, especially from Southeast Asia and these differences were further magnified among women who were primipara or 20–34 years old. Furthermore, these findings revealed several demographic factors that were significantly associated with adverse birth outcomes. Second, birth outcomes from the immigrant group and a vulnerable group of native Koreans were compared, and found that the immigrants group exhibited more favorable birth outcomes than their native counterparts. Therefore, it appears that policies should be developed to support both immigrants and disadvantaged native groups, such as parents with low education or parents who are unemployed. Third, it is expected that the number of immigrants will continue to increase, which highlights the importance of identifying disparities in women's status and birth outcomes. These results can provide baseline data for policies that support immigrants successfully settling in Korea, living healthy lives, and experiencing positive birth outcomes, which can help reduce the economic

burden on the immigrants and the Korean healthcare system.

G. Conclusions

Hypotheses of this study were the proportions of adverse birth outcomes would be higher among immigrant women, compared to those among native Koreans, and there would be socioeconomic factors that are related to those birth outcomes in the immigrant group. This study has provided evidence regarding the disparities in the risks of preterm birth, low birth weight and SGA among immigrant women and native women in Korea. Especially there was higher risk of SGA among immigrant group and immigrants from Southeast Asia were most vulnerable. Otherwise, several results of analyses showed possibility of the health migrant effect. There were weak correlations between socioeconomic factors such as education level and occupations of parents, and effect on birth outcomes of these factors were not significant while pre-immigration and early post-immigration statuses may significantly affect birth outcomes. However, there are several limitations in this research thus to accurate assess the precise status of birth outcomes, thus to identify the causes of adverse birth outcomes, additional information regarding perinatal health and socioeconomic factors is needed. Therefore, it would be helpful to develop a more comprehensive national birth registry or to evaluate birth cohort of immigrant women who have more available data. Furthermore, qualitative research regarding immigrant women can provide additional detailed information regarding their unmet needs during the perinatal period. Moreover, future studies should examine additional health conditions (beyond birth outcomes) among immigrants, such as infant mortality, developmental delay, and growth retardation. These data will be necessary to develop comprehensive policies that reduce health disparities and support the successful settlement of immigrants in Korea.

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국문초록

대한민국에 거주하는 이주 여성의 부정적 출산 결과 현황과 위험인자 분석

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연구배경

지난 20년간 대한민국에 거주하고 있는 이주민의 수는 급격히 증가하였으며 이주 여성으로부터 출생하는 아동의 수도 증가하여 연간 출생 수의 약 4.3%를 차지하고 있다. 하지만 이주 여성에서의 미숙아, 저체중출생아 및 부당경량아 출산 현황에 대한 정보는 현재까지 많지 않다.

연구방법

본 연구는 2010년부터 2013년까지 통계청에 등록된 출생자료를 분석하여 이주여성으로부터 출생한 68,074명의 단태아와 대한민국 여성(내국인)으로부터 출생한 1,644,956명의 단태아에서 미숙아, 저체중출생아 및 부당경량아의 비율 및 관련 인자를 비교 분석하였다. 또한 엄마의 출신 국가, 나이, 출산력, 출생 지역 등에 따라 하위군 분석을 하여 어느 군에서 비율의 차이가 큰지 알아보았고, 이주 여성과 내국인 중 취약계층과도 비교해보았다. 그리고 관련 인자를 확인하고자 인구, 사회경제적 요인으로 다항 분석을 시행하였다.

연구결과

출산 관련 인자(아기의 성별, 엄마의 나이, 결혼 상태, 출산력)로 보정하여 두 군을 비교하였을 때 미숙아(4.9% vs. 4.6%, $p < 0.001$), 저체중출생아(4.2% vs. 3.6%, $p < 0.001$), 부당경량아(5.7% vs. 7.2%, $p < 0.001$)의 비율은 이주 여성에서 의미 있게 높았다. 하지만 사회경제학적 요인(출생 지역, 부모의 교육 수준, 직업)으로 추가 보정하였을 때에는 이주 여성에서 의미 있게 낮았으나 부당경량아의 비율은 의미 있게 높았다. 이러한 결과는 동남아시아에서 온 이주 여성에게서도 유사하게 나타났으나 중국, 유럽, 아메리카에서 온 경우에는 미숙아, 저체중출생아 및 부당경량아의 비율이 내국인과 비슷하거나 오히려 낮았다. 하위군 분석 시에는 초산과 엄마의 나이가 20 ~ 34세 일 때 이주 여성에게서 의미 있게 그 비율이 유의하게 높은 것으로 확인되었다. 내국인 중 부모의 교육 수준이 고졸 이하이거나 아버지가 무직인 경우와 이주 여성을 비교하였을 때에는 이주 여성에서 미숙아 출산률이 낮았고, 저체중출생아의 비율은 두 군에서 유사하였다. 다항 분석에서는 아기의 성별, 부모의 나이, 엄마 출신 국가의 경제적 수준이 미숙아 및 저체중출생아의 출산 위험과 관계가 있는 것으로 예상 되었으며 인구, 사회경제적 요인으로 모두 교정하였을 때에는 미숙아 및 저체중출생아 출산의 위험이 이주 여성에서 더 낮았으며 부당경량아의 출산 위험은 더 높았다.

결론

이번 연구를 통하여 이주 여성과 내국인 여성에서 미숙아, 저체중출생아 및 부당경량아 출산 비율의 차이가 있음을 확인할 수 있었다. 정확한 현황 파악 및 원인 파악을 위해서는 산모 및 아기의 건강 상태 등에 대한 추가적 정보가 필요하다. 이 연구는 이주민의 성공적인 정착과 건강불평등을 줄일 수 있는 정책 마련의 기초 자료가 될 수 있을 것으로 기대한다.

… …

주요어 : 이주 여성, 미숙아, 저체중출생아, 부당경량아, 건강 불평등, 대한민국

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The risk factors of adverse birth outcomes among immigrant women in the Republic of Korea

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The risk factors of adverse birth outcomes among immigrant women in the Republic of Korea

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이 논문을 보건학 석사 학위 논문으로 제출함

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서울대학교 보건대학원

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Abstract

The risk factors of adverse birth outcomes among immigrant women in the Republic of Korea

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Background

The Republic of Korea (Korea) experienced increases in births from immigrant women steadily over the last 20 years, accounting for a substantial proportion of total births (4.3 %). Nevertheless, little is known about birth outcomes of immigrant women in Korea.

Methods

This study compared the birth data of immigrant and native women in Korea and explored factors affecting birth outcomes of immigrant women. A total of 68,074 singletons from immigrant women and 1,644,956 singletons from natives were examined based on the National Birth Registration Database between 2010 and 2013.

The outcomes included preterm births, low birth weight and small for gestational age (SGA). Adjusted proportions for the occurrence of preterm births, low birth weight and SGA were calculated, and performed subgroup analysis according to maternal original nationalities, maternal age, parity, and birth region. The birth outcomes of the immigrant group to a vulnerable group in Korea were compared. Add to that, the associated factors with those birth outcomes were assessed in multivariate analyses adjusted for demographic and socioeconomic factors.

Results

After adjusted for birth-related factors (infant sex, maternal age, marriage status, and parity) the adjusted proportions for preterm birth (4.9% vs. 4.6%, $p < 0.001$), low birth weight (4.2% vs. 3.6%, $p < 0.001$) and SGA (5.7% vs. 7.2%, $p < 0.001$) were significantly higher for immigrants than natives. However, after additionally adjusted for socioeconomic factors (birth region, parental education level, and occupation), preterm birth and low birth weight were significantly more favorable but SGA were still unfavorable in the immigrant group. The results were similar in the subgroup analysis for immigrants from Southeast Asia, but immigrants from China, Europe, or America revealed similar or more favorable outcomes compared to the native group. The results of stratified analyses showed that primiparous immigrant women and those between the ages of 20-34 had significantly higher proportions of adverse birth outcomes relative to native women. The results that compared to less educated parents or unemployed fathers in the native group revealed that the immigrant group had lower proportion of preterm birth and comparable proportion of low birth weight. Multivariate analysis showed that infant sex, parental ages and economic level of maternal original countries were related to preterm birth and low birth weight. After adjustment with all demographic and socioeconomic factors, the risks of preterm birth and low birth weight was lower, and that of SGA was higher in the immigrant group compared to the native group.

Conclusions

This study has provided evidence regarding the disparities in the risks of adverse birth outcomes among immigrant women and native women in Korea. However, to accurate assess the precise status of birth outcomes, and to identify the causes of adverse birth outcomes, additional information (e.g., health status of mothers and infants, monthly income, durations of residency in Korea) is needed. These data will be necessary to develop comprehensive policies that can reduce health disparities and support the successful settlement of immigrants in Korea.

… …

Keywords: Immigrants, Preterm birth, Low birth weight, Small for gestational age, Birth outcomes, Health disparities, Republic of Korea

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I. Introduction

A. Research Background

The Republic of Korea (Korea) has historically been considered a homogeneous country, although increasing numbers of foreign workers and marriage-based immigrants during the last two decades have altered this perception. There were approximately 1.5 million immigrants living in Korea during 2015, which accounted for approximately 3% of the Korean population. The number of immigrant families had also increased to 266,547 families in 2012, and 83% of these families were marriage-based immigrant families. The increased number of immigrant families has led to increased numbers of births to immigrant families, which accounted for 4.3% of all births during 2012 (Lee et al., 2012; Statistics Korea, 2015). Therefore, to support and care for immigrant women, the Korean government has enacted laws that require that these women be educated regarding perinatal care and receive medical check-ups during pregnancy, postpartum care, and translation services. Furthermore, immigrant mothers can receive the same benefits as their Korean counterparts, which include perinatal care, emergency treatment, neonatal healthcare, and vaccinations (Ministry of Gender Equity and Family, 2014). However, few studies have examined adverse birth outcomes among immigrant women, such as preterm birth, low birth weight and small for gestational age (SGA), and this information would be useful for assessing the effectiveness of the current policies.

Preterm birth is defined as birth before 37 weeks of gestational age, and low birth weight is defined as a birth weight of <2,500 g. There is another concept, SGA, which means that a birth weight less than the tenth percentile in the gestational age, and this is usually caused by fetal growth restriction (Martin, Fanaroff, & Walsh, 2014; World Health Organization, 2014). The sequelae of preterm birth or low birth weight include mental retardation, spastic diplegia, hearing and vision impairment,

and failure to thrive. These sequelae can increase the parents' stress and result in child abuse, neglect, and/or divorce (Kliegman, 2012). Moreover, preterm birth and low birth weight are important causes of perinatal mortality and morbidity. Preterm birth is the second most common cause of under-five mortality and babies whose birth weight were <2,500g have 20 times higher mortality rate compared to birth weight of ≥2,500g (Goldenberg et al., 2008; Kim, 2008; Lee, 2009; Rhee, 2013). If the degree of growth restriction in SGA is extreme, it can cause short-term metabolic problems and even neonatal death (Kramer et al., 1990). Less extreme SGA is known to be associated with mild, long-term deficits in growth and neurocognitive performance, and long-term associations with chronic adult diseases, such as hypertension, type 2 diabetes and coronary heart disease (Hack, 1998; Goldenberg, Hoffman, & Cliver, 1998; Barker, 1992). In addition, adverse birth outcomes place an economic burden on the family, and previous studies have reported that hospital costs are inversely related to gestational age (Petrou, 2003; Yoon, 2009). Furthermore, the parents must make out-of-pocket payments for travelling and accommodations (Tommiska, Tuominen, & Fellman, 2003). Moreover, parents typically pay more for preterm infants after the initial hospital discharge, compared to at-term infants (Petrou, 2005; Petrou, Eddama, & Mangham, 2011). Therefore, as preterm infants can have multiple comorbidities and are more susceptible to many diseases, they can create a greater economic burden, compared to at-term infants. Both preterm birth rate (4.3 in 2001 and 6.0 in 2011) and low birth weight rate (3.0 in 1995 and 5.5 in 2013) have been increased for last two decades in Korea and this might be because increased maternal age and the number of people who received artificial reproductive technology (Rhee, 2013; Yoon, 2014).

B. Research Purpose

Policies have been developed to support the increasing numbers of immigrant families and births. However, few large studies regarding birth outcomes among immigrant women have evaluated the maternal and child health statuses among immigrants to Korea. This study aimed to describe the current status of birth outcomes (preterm birth, low birth weight and small for gestational age) among immigrant women, and to compare these outcomes to those from a group of native Koreans, in order to evaluate the disparities in birth outcomes and to identify the socioeconomic factors that may affect these outcomes.

C. Research Hypotheses

(1) The proportions of preterm birth, low birth weight and small for gestational age will be higher among immigrant women, compared to those among native Koreans.

(2) There will be socioeconomic factors that are related to the birth outcomes in the immigrant group.

Ⅱ. Literature review

A. Immigrant women in Korea

There was a study on analyzing 15,341 immigrant families that a couple was composed of one immigrant and one Korean native in Korea in 2012. Over 80% of the study subjects were immigrant women (83.5%) and 16.5% was male. According to the study, approximately 80% of immigrants in these families came from Asian countries (e.g., China, Vietnam, Japan, and the Philippines, in order), and approximately 60% are currently living in the area of Korea's capital (Seoul, Incheon and Gyeonggi-do). About 80% of female immigrants and 65% of male immigrants educated less than 12 years, and the percentage of school attendance of children in immigrant families was also lower than native families (high school, 85.1% vs. 92.6%; college or over, 49.3% vs. 68.4%). Twenty one percent of immigrants reported language problems and 19.8% reported financial problems. Approximately 40% of them had experience of discrimination, especially over 50% of immigrants from Southeast Asia suffered discrimination but less than 30% of immigrants from the United States (28.5%) or Japan (29.8%) encountered discrimination. Among immigrants, 53.0% of female and 80.3% of male were employed and among unemployed immigrants, 45.1% reported the main reason of unemployment was language problem. Moreover, 89% of immigrant families had an average monthly income that was lower than the national average monthly income (Korean Women's Development Institute, 2013; Statistics Korea, 2015). According to a study on marriage based immigrant women, the main reason of their international marriage was economic problem. Especially for immigrant women from Southeast Asia, because of economic crisis in their homeland, they chose marriage based immigrant even their educational level was high (Kim, 2011).

B. Factors related to adverse birth outcomes

Preterm birth is defined as birth before 37 weeks of gestational age. It can be further subdivided into moderate/late preterm (32 to <37 weeks), very preterm (28 to <32 weeks) and extremely preterm (<28 weeks). Low birth weight is defined as a birth weight of <2,500 g, and subcategories include very low birth weight, which is less than 1500g, and extremely low birth weight, which is less than 1000g. Prognosis of neonates is directly correlated with their gestational age and birth weight. SGA is defined as a birth weight less than the tenth percentile in the gestational age (Martin, Fanaroff, & Walsh, 2014; World Health Organization, 2014). There are several known risk factors for preterm birth, low birth weight and SGA, which include placental factors (e.g., placental insufficiency and multiple gestation), maternal factors (e.g., low and high maternal age, single marital status, parity, African-American and South Asian, malnutrition, chronic diseases, and pregnancy-related diseases), environmental factors (e.g., medications, assisted reproductive technology, and country of origin), and fetal factors (e.g., genetic factors and chromosomal disorders) (Martin et al., 2014; Goldenberg et al., 2008). In addition, socioeconomic factors can affect birth outcomes, and Parker et al. have reported that almost all socioeconomic indices (maternal and paternal education, maternal and paternal occupation, and family income) were related to low birth weight among both black and white women. In that study, poor or less educated parents were at higher risk of preterm birth and low birth weight, and mothers who were professional or managerial women were at lower risk of preterm birth, compared to all other occupation categories. The researchers supposed that factors likely to be related to socioeconomic factors such as appropriate health habits during pregnancy may influenced fetal growth and premature birth (Parker, Schoendorf, & Kiely, 1994). Furthermore, a Canadian study revealed that maternal education was related to preterm birth, and that preterm birth due to educational inequalities birth have

increased (Auger, Roncarolo, & Harper, 2011). Moreover, in 2011, Shin et al. reported that parental under-education and unemployment increased the risk of preterm birth in Korea. They explained that less educated mothers were reported less likely to receive appropriate prenatal care and a low educational level may limit a person's access to jobs and other social resources that results poverty, and more likely to be malnourished and have unhealthy habits (smoking, alcohol consumption, and drug abuse) (Shin et al., 2012). Effect of parental unemployment status on adverse birth outcomes has been debatable. Some previous studies have shown that maternal unemployment was significantly associated with preterm birth (Hanke et al. 2001; Rodrigues and Barros 2008). They explained that material and financial insufficiency make maternal daily living difficult and lead to anxiety about the future, and they presumed that these stress could be an element in the mechanism of the association between unemployment and preterm birth (Hanke et al. 2001). Furthermore, women who ever worked during pregnancy tend to be better informed, have healthier behaviors towards pregnancy, easily access to health care and increased social support, and these make low risk of preterm birth among employed women (Rodrigues and Barros 2008). Whereas, others have shown that no increased risk of preterm birth among unemployed women and lower educational level and income, and they reported increased maternal stress and the risk of adverse birth outcomes affect birth outcomes rather than unemployment (Saurel-Cubizolles and Gestin 1991; Jansen et al. 2009). Some researches explained this debate with the effect of working conditions. Brett et al. reported that compared to low-strain jobs, unemployment and high-strain jobs led to an increased risk of preterm birth, and a meta-analysis showed that a significant association between physically demanding jobs and preterm births. This might be because physical and mental stress during pregnancy reduce the blood flow through the uterine arteries and affected fetal development and birth weight. Furthermore, women who have high-strain jobs are more frequently exposed

to prolonged standing or pesticides that may cause adverse birth outcomes (Brett et al. 1997; Mozurkewich et al. 2000; Jansen et al. 2009). Paternal unemployment status also can be associated with preterm births or low birth weight. Cole et al. reported that unemployed fathers have less income and higher stress in financial and marriage, and the family become low social class that may be related to low birth weight and preterm birth (Cole et al. 1983). Shin et al. explained an increased risk of preterm birth among unemployed parents in Korea with health insurance status. In Korean health insurance system, if both spouse are unemployed, they are categorized as self-employed insured and burden of insurance contribution can be increased. Therefore, they are less likely to use health care service including perinatal care and it lead to the increased risk of preterm birth (Shin et al., 2012).

C. Perinatal health of immigrants

The results of previous studies regarding birth outcomes among immigrants are debatable. For example, Mexico-born and North African-born women in the United States, France, and Belgium have good birth outcomes, and some researchers assume that immigrants may have protective behaviors that promote healthy birth outcomes (Guendelman et al., 1999). Immigrants in Mexico also had more favorable birth outcomes than natives, which the authors deduced using healthcare insurance claims data (Frank & Hummer, 2002). Several studies reported similar outcomes and explained with the healthy migrant theory, which means that healthier people are more likely to migrate and be mobile, and they could have better birth outcomes than those who do not move (Wingate & Alexander, 2006). Auger et al. reported that the healthy migrant effect was present only in mothers with low education because for immigrant women of higher education could have greater stress adapting to new environment, and it might result adverse birth outcomes (Auger et al., 2008).

In contrast, a Swedish study that was performed between 1978 and 1990 revealed that women from Asia, the Pacific Islands, and Sub-Saharan Africa had higher risks of preterm birth and low birth weight, compared to women from Finland (Rasmussen, Oldenburg, Ericson, & Gunnarskog, 1995). Another Swedish study that was performed between 1987 and 2008 reported similar results, which indicated that immigrant mothers from Asia and Sub-Saharan Africa had a higher risk of preterm birth (Urquia, Qiao, Ray, Liu, & Hjern, 2015). Furthermore, a systematic review of perinatal health among immigrants in industrialized Western countries revealed that birth outcomes varied according to the country from which the mother immigrated. For example, Asian and sub-Saharan African immigrants had a higher risk of preterm birth, which might be related to gender-based violence, posttraumatic stress disorder, language challenges, nutritional issues, and an increased risk of infection (Gagnon, Zimbeck, & Zeitlin, 2009). In contrast, immigrant women from Eastern Europe exhibited favorable birth outcomes, which might be explained by the healthy migrant hypothesis. (Janevic, Savitz, & Janevic, 2011; Wingate & Alexander, 2006).

Furthermore, a study of maternal health among marriage-based immigrant women in Republic of Korea reported that the immigrant group received less perinatal care, had a high risk of poor nutritional status, and experienced language challenges when they visited hospitals (Kim, 2009). The results of another study of maternal health among immigrant women show that 21.4% of pregnant women did not have perinatal care and only 64.1% have knowledge about contraception. And about 70% of them get perinatal health information from their family or neighborhood rather than public health centers or hospitals (Jeong et al., 2009). There are also two single-center studies of birth outcomes among immigrant women in Korea. Jang et al. reported that the incidence of congenital anomalies was higher in the immigrant group, and the authors hypothesized that this could be related to relatively old paternal age (Jang et al., 2013). The other study revealed that immigrant mothers had low body

mass index values before they became pregnant, were less likely to consume iron supplements, and that their infants were more likely to be admitted to neonatal intensive care units (Lee et al., 2013).

D. Health problems of immigrant children

Park et al. (2008) reported birth weight of 333 babies from immigrant women who gave birth in 9 tertiary hospitals from 2005 to 2008. In this report, mean birth weight of immigrant women (2,869.1 ± 685.3g) was significantly lower than that of native women (2,995.1 ± 689.8g) (Jeong et al., 2009). Hwang and Jeong (2008) reported that there were significantly different speech and language performance between children in immigrant women and native women. Children with mothers from Japan showed statistically higher performances than children with mothers from the Philippines. And the language characteristics of the children in the multicultural family had a high correlation to children's verbal and non-verbal intelligence, their mother's Korean language abilities, and educational experiences (Hwang & Jeong, 2008). Kim and Lee (2013) reported that developmental level in personality, sociality, reading and writing area in children from immigrant women was lower than natives but development of scientific thinking and mathematical thinking showed no differences (Kim & Lee, 2013).

Ⅲ. Methods

A. Data

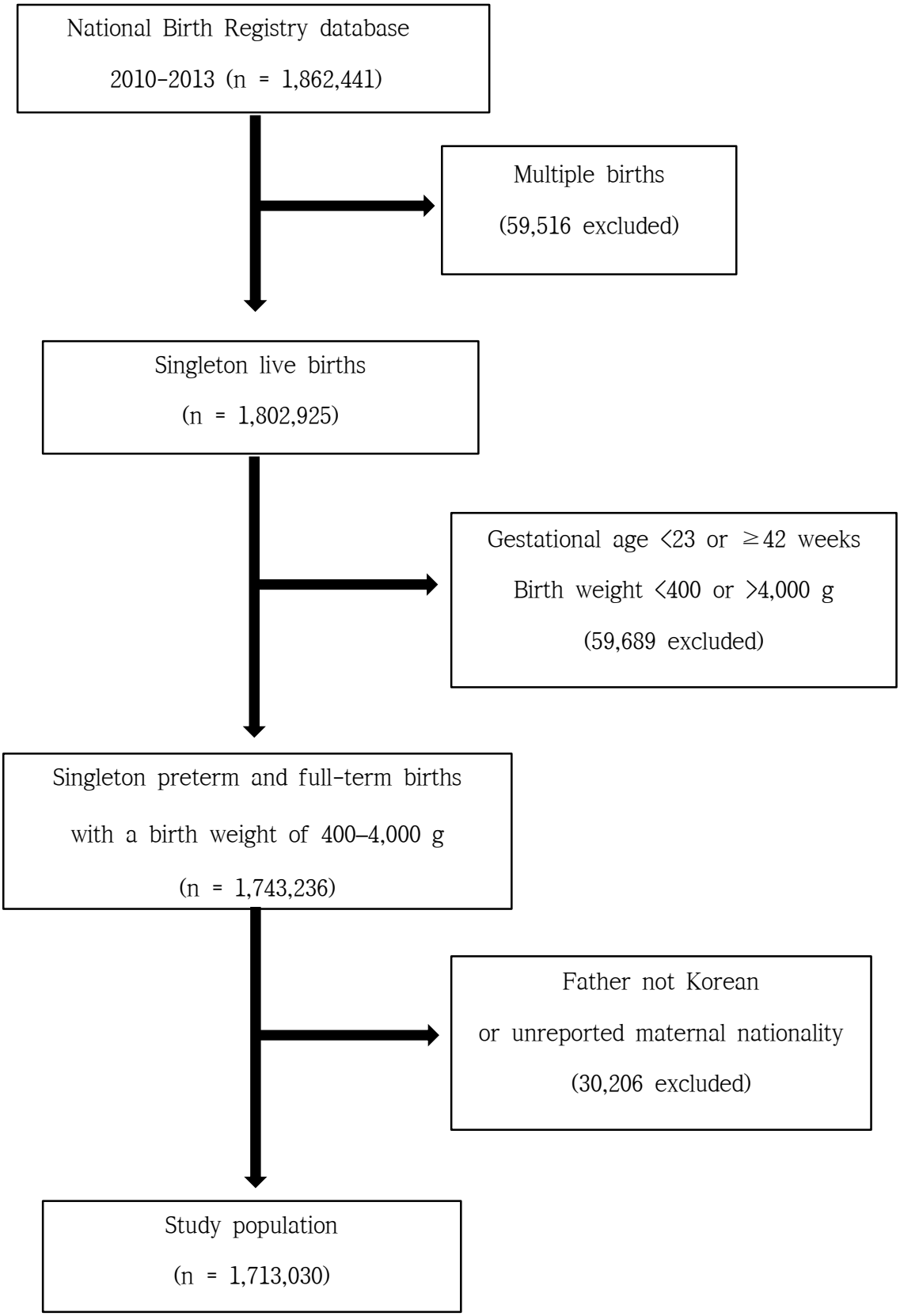
1. Study design and data source

This nationwide registry-based study examined data from 1,862,441 live births during 2010–2013, which were recorded in the Korean national birth registry. The proportions of preterm birth, low birth weight and SGA were compared among immigrant women and native Koreans, and a cross-sectional analysis of the immigrant women and native Koreans were performed to identify socioeconomic factors that affected adverse birth outcomes. In Korea, all parents must register their child' s birth within 1 month at the community centers, and must provide the following information: date of birth, maternal residential address at the time of birth, place of birth (hospital or not), parental ages, gestational age, sex, birth order in multiple pregnancy, total number of births, parental education, and parental occupation. However, whether parents are alive or not, and level of monthly income or possessions are not required to report. After 2010, parents are also required to indicate whether they are Korea-born natives or they has been naturalized, and/or their original nationality. However, immigrants do not need to fill up the duration of stay in Korea. The data was obtained from the website of Statistics Korea. Anyone can get data from the website if they register a research plan and pay cost per data quantity. The personal identification numbers were removed from the records to protect the individuals' privacy. For this reason, all birth data were treated as from different families, even if one couple gave birth twice or more during the period.

Exclusion criteria were established to compare birth outcomes of immigrant and native women. As multiple births are an important cause of preterm birth and low birth weight, 59,516 cases (3.2%) that involved multiple births were excluded. In

addition, to compare preterm birth and term birth, data for post term birth (a gestational age of ≥42 weeks) were excluded and to compare low birth weight and normal birth weight, data for large for gestational age (a body weight of >4,000g) were excluded. In Korea, a gestational age of <23 weeks or birth weight of <400g are still gray zones for active resuscitation in the delivery room thus data in these ranges were excluded to remove the potential confounding effects on these analyses (59,689, 3.2%). Moreover, to ensure that complete data regarding birth outcomes from only among immigrant women were obtained, cases in which the father's original nationality was not Korean or in which the mother's nationality was not reported were excluded (30,206, 1.6%) (Fig. 1). Thus, the final analyses evaluated data from 1,713,030 births.

Figure 1. The study flow chart



2. Variables

1) Dependent variables (adverse birth outcomes)

The dependent variables in this study were the proportions of preterm birth, low birth weight and SGA in term infants. Preterm birth was defined as <37 completed weeks of gestation and low birth weight was defined as a birth weight of <2,500 g, based on the definition from the World Health Organization (World Health Organization, 2014). SGA in term infants was defined as smaller than the gender-specific 10^{th} percentile for their gestational age (≥37 week) at birth according to the Fenton growth chart 2013 (University of Calgary, 2013).

2) Independent variables

The main independent variable in this study was the mother's original nationality, which was used to categorize women as either immigrants or native Koreans. To identify the effect of the mother's nationality on birth outcomes, the immigrant mothers' nationalities were subdivided into high-/upper-middle-income countries and low-/lower-middle-income countries, using the World Bank's data regarding each country's per-capita Gross National Income (GNI; in US dollars). For the 2016 fiscal year, low-income countries had a 2014 per-capita GNI of ≤$1,045, middle-income countries had a per-capita GNI of $1,046–12,735, and high-income countries had a per-capita GNI of ≥$12,736. Lower-middle-income and upper-middle-income countries were separated using a per-capita GNI of $4,125 (World Bank, 2015). Furthermore, for subgroup analysis, immigrants were subdivided according to the continents that their countries were belonged (Asia, Europe, America and Africa).

3) Control variables

Several socioeconomic and pregnancy-related factors in the national birth registry were controlled for. These factors included infant sex, place of birth, area of birth, parental marriage status, maternal parity, paternal and maternal age, maternal and paternal education level, and maternal and paternal occupation. The place of birth was defined as being in a hospital or not. The area of birth was categorized as metropolitan city or not, using the government-designated geocodes. Marriage status was classified as married or unmarried when the baby was born, and parity was defined as primiparous (the first delivery) or multiparous (second or over). Paternal age at delivery was categorized as <20 years, 20–29 years, 30–39 years, and ≥40 years. Maternal age at delivery was categorized as <20 years, 20–34 years, and ≥35 years. Education level was divided into high school or lower (≤12 years of education) and college or higher (≥13 years of education). Parental occupations were classified as managers or specialists, clerical support workers, service workers, blue-collar workers, and unemployed (no occupation, housewife, or student).

B. Statistical analysis

The Spearman's rank correlation coefficients were performed to assess the correlation between socioeconomic factors and with birth outcomes (preterm births, low birth weight and SGA). The χ^2 test was used to compare the proportions of adverse birth outcomes among immigrants and native Koreans, and the tests were adjusted for the control variables in two steps. First, for pregnancy- and birth-related factors (infant sex, marital status, parity, and maternal age) were adjusted for, and then socioeconomic factors (area of birth, paternal and maternal occupation, paternal and maternal education) were controlled for. Add to that, subgroup analyses for the proportion of very preterm births and very low birth weight were performed. In order to assess the differences by maternal original nationalities in immigrant

group, analyses were performed according to the continents (Asia, Europe, and America). As the number of data was limited to analysis (7 people), analysis for immigrants from Africa was not performed. Additional analyses were performed for immigrants from China and Southeast Asia as they comprised the great majority of immigrants group, and each group accounted for 26.3% and 59.9%. Furthermore, subgroup analyses were performed for birth outcomes according to maternal age (<20 years, 20–34 years, or ≥35 years), area of birth (metropolitan city or not), and parity (primiparous or multiparous) and these analyses were adjusted for the birth-related factors (infant sex, marital status, parity, and maternal age). Add to that, to compare the immigrants' outcomes with those of a vulnerable social group in Korea, the outcomes for immigrant women and the outcomes for native-born women and their partners who had low education or were unemployed were compared, and these analyses were adjusted for the birth-related factors. Additionally, comparison between the vulnerable groups and the immigrants from Southeast Asia which had the worst birth outcomes among immigrants was performed. Multivariate logistic analyses were performed to identify factors that affected adverse birth outcomes among the native, the immigrant group and both.

All analyses were performed using STATA software (version 12.1; StataCorp, College Station, TX, USA), *P*-values of <0.05 were considered statistically significant, and odds ratios (ORs) 95% confidence intervals (CIs) were used to describe the strengths of the associations.

C. Ethics statement

The survey protocol was granted an exemption by the Institutional Review Board at the Seoul National University, because this was a secondary analysis of de-identified data.

IV. Results

A. Demographic and birth-related characteristics

Table 1 shows the demographic and birth-related characteristics of the 1,713,030 birth records analyzed. In the immigrant group, the fathers were typically older and the mothers were typically younger, compared to the native Korean group (fathers: 6.2 years older, mothers: 4.1 years younger). Approximately 70% of the native Koreans were educated to a college level or higher, and approximately 70% of the immigrants were educated to a high school level or lower. The immigrant group contained a significantly greater proportion of primipara women, compared to the native Korean group (61.0% vs. 51.1%, respectively; $P < 0.001$). In the immigrant group, most mothers (62.0%) were from low-/lower-middle-income countries, and most immigrant mothers came from Asian countries (60.0%).

Table 1. Demographic and birth-related characteristics of the study population (n = 1,713,030)

Characteristics	Native Koreans, n (%) or mean (SD) (n = 1,644,956)	Immigrants, n (%) or mean (SD) (n = 68,074)	*P*-value
Infant sex			
Male	839,072 (51.0)	34,761 (51.1)	0.779
Female	805,884 (49.0)	33,313 (48.9)	
Marital status			
Married	1,623,352 (98.7)	67,646 (99.4)	<0.001
Unmarried	21,604 (1.3)	428 (0.6)	
Paternal age (years)			
Mean	33.5 (4.3)	39.7 (5.8)	<0.001
<20	2,692 (0.2)	7 (0.0)	<0.001
20–29	262,966 (16.0)	2,531 (3.7)	
30–39	1,243,534 (75.7)	30,140 (44.4)	
≥40	134,679 (8.2)	35,165 (51.8)	
Maternal age (years)			
Mean	31.2 (3.9)	27.0 (5.4)	<0.001
<20	6,161 (0.4)	2,534 (3.7)	<0.001
20–34	1,377,225 (81.3)	58,547 (86.1)	
≥35	301,473 (18.3)	6,948 (10.2)	
Area of birth			
Metropolitan city	727,158 (44.2)	23,718 (34.9)	<0.001
Others	917,798 (55.8)	44,356 (65.1)	
Place of birth			
Hospital	1,618,945 (98.5)	67,032 (98.5)	0.078
Others	25,375 (1.5)	992 (1.5)	
Paternal education			
College or higher	1,195,763 (72.8)	22,404 (33.1)	<0.001
High school or lower	446,180 (27.2)	45,236 (66.9)	
Maternal education			
College or higher	1,183,744 (72.1)	17,887 (26.5)	<0.001
High school or lower	458,690 (27.9)	49,559 (73.5)	
Paternal employment			
Manager or specialist	461,544 (28.1)	10,562 (15.5)	<0.001
Officer	569,396 (34.6)	12,903 (19.0)	
Service	281,995 (17.1)	12,272 (18.0)	
Blue collar	271,138 (16.5)	28,455 (41.8)	
Unemployed [a]	60,883 (3.7)	3,882 (5.7)	
Maternal employment			
Manager or specialist	217,102 (13.2)	1,798 (2.7)	<0.001
Officer	242,314 (14.7)	1,382 (2.0)	
Service	75,747 (4.6)	1,034 (1.5)	
Blue	28,668 (1.7)	3,244 (4.8)	
Unemployed [a]	1,081,125 (65.8)	60,616 (89.0)	
Parity			
Primiparous	840,098 (51.1)	41,462 (61.0)	<0.001

Multiparous	803,834 (48.9)	26,547 (39.0)	
Maternal country			
High and upper-middle income	NA	25,780 (38.0)	-
Asia		23,511 (34.7)	
Europe		483 (0.7)	
America and Pacific region		1,786 (2.6)	
Africa		0 (0.0)	
Low and lower-middle income	NA	42,027 (62.0)	-
Asia		40,651 (60.0)	
Europe		1,369 (2.0)	
America and Pacific region		0 (0.0)	
Africa		7 (0.0)	

a. Unemployed: unemployed, housewife, or student

SD: standard deviation, NA: not applicable.

B. Correlations among variables

Among native women, mother's education level was moderately correlated with father's education level. Otherwise, other socioeconomic factors showed weak correlations among each other, and socioeconomic indices and adverse birth outcomes showed very weak correlations. Among immigrants, mother's education level was weakly correlated with father's education level and occupation, and paternal education level showed weak correlation with paternal occupation. As in the natives group, immigrants showed very weak correlation between socioeconomic factors and birth outcomes. In general, the size of values from Spearman rank coefficient tests were similar or smaller in the immigrants group, compared to natives group (Table 2).

Table 2. Correlations between socioeconomic factors and birth outcomes (Spearman rank coefficients), by maternal nationalities

	Preterm	LBW	SGA	Father's occupation	Mother's occupation	Father's education	Mother's education
Natives							
Preterm	1.0	0.481	.	0.013	0.012	0.026	0.030
LBW		1.0	0.424	0.011	0.008	0.023	0.025
SGA			1.0	0.005	0.003	0.009	0.008
Father's occupation				1.0	0.205	0.310	0.241
Mother's occupation					1.0	0.201	0.239
Father's education						1.0	0.495
Mother's education							1.0
Immigrants							
Preterm	1.0	0.432	.	0.002	0.002	0.003	0.004
LBW		1.0	0.438	0.014	0.007	0.012	0.009
SGA (term)			1.0	0.016	0.006	0.014	0.018
Father's occupation				1.0	0.065	0.337	0.264
Mother's occupation					1.0	0.124	0.146
Father's education						1.0	0.396
Mother's education							1.0

LBW: Low birth weight

SGA: Small for gestational age in term infants

C. Adverse birth outcomes among immigrant women in Korea

1) Preterm birth

The proportion of preterm birth in the immigrant group was higher than that in the native Korean group, although this difference was not statistically significant (4.7% vs. 4.6%, $P = 0.255$). After adjusting for the birth-related factors, the proportion of preterm birth remained significantly higher in the immigrant group (4.9% vs. 4.6%, $P < 0.001$). However, after adjusting for birth-related and socioeconomic factors, preterm birth was more prevalent in the native Korean group (4.6% vs. 4.0%, $P < 0.001$) (Table 3). In the subgroup analysis, the proportion of very preterm (<32 weeks) was significantly higher in the native Korean group (1.0% vs. 0.9%, p = 0.037).

2) Low birth weight

The proportion of low birth weight was significantly higher in the immigrant group (4.2% vs. 3.7%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (4.2% vs. 3.6%, $P < 0.001$). However, after adjusting for birth-related and socioeconomic factors, the proportion of low birth weight was significantly higher in the native Korean group (3.6% vs. 3.4%, $P = 0.003$) (Table 3). Subgroup analysis of the proportions of very low birth weight revealed that it was significantly more frequent in the native Korean group (0.4% vs. 0.3%, $P < 0.001$).

3) Small for gestational age in term infants

The proportion of SGA was significantly higher in the immigrant group (8.1% vs. 6.1%, $P < 0.001$), and similar results were observed after adjusting for birth-related factors and socioeconomic factors (Table 3).

Table 3. Analyses of the proportions of preterm birth, low birth weight, and small for gestational age (SGA) in term infants.

	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants (%)	*P*-value	Native Koreans (%)	Immigrants (%)	*P*-value	Native Koreans (%)	Immigrants (%)	*P*-value
Preterm birth	4.6	4.7	0.255	4.6	4.9	<0.001	4.6	4.0	<0.001
Low birth weight	3.7	4.2	<0.001	3.6	4.2	<0.001	3.6	3.4	0.003
SGA in term infants	6.1	8.1	<0.001	5.7	7.2	<0.001	5.7	6.4	<0.001

a. Adjusted for infant sex, maternal age, marriage status, and parity

b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

D. Subgroup analysis according to maternal original nationalities

1) Asia

(1) Preterm birth

The proportion of preterm birth in the immigrant women from Asian countries was not significantly different from the native group (4.8% vs. 4.7%, $P = 0.168$). After adjusting for the birth-related factors, the proportion of preterm birth was significantly higher in the immigrant group (4.9% vs. 4.6%, $P < 0.001$). However, after adjusting for birth-related and socioeconomic factors, preterm birth was more prevalent in the native Korean group (4.6% vs. 4.0%, $P < 0.001$) (Table 4).

(2) Low birth weight

The proportion of low birth weight was significantly higher in the immigrant group (4.3% vs. 3.7%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (4.2% vs. 3.6%, $P < 0.001$). However, after adjusting for birth-related and socioeconomic factors, the proportion of low birth weight was significantly higher in the native Korean group (3.6% vs. 3.4%, $P = 0.003$) (Table 4).

(3) Small for gestational age in term infants

The proportion of SGA was significantly higher in the immigrant group (8.2% vs. 6.1%, $P < 0.001$), and similar results were observed after adjusting for birth-related factors (7.2% vs. 5.7%, $P < 0.001$), and birth-related and socioeconomic factors (6.5% vs. 5.7%, $P < 0.001$) (Table 4).

Table 4. Analyses of adverse birth outcomes among Korean natives and immigrant women from Asia

	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants from Asia (%)	*P*-value	Native Koreans (%)	Immigrants from Asia (%)	*P*-value	Native Koreans (%)	Immigrants from Asia (%)	*P*-value
Preterm birth	4.7	4.8	0.168	4.6	4.9	<0.001	4.6	4.0	<0.001
Low birth weight	3.7	4.3	<0.001	3.6	4.2	<0.001	3.6	3.4	0.003
SGA in term infants	6.1	8.2	<0.001	5.7	7.2	<0.001	5.7	6.5	<0.001

a. Adjusted for infant sex, maternal age, marriage status, and parity

b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

SGA: Small for gestational age in term infants

2) China

(1) Preterm birth

The proportion of preterm birth in the immigrant women from China was significantly lower than that in the native Korean group (4.2% vs. 4.7%, $P = 0.004$). Even after adjusting for the birth-related factors (4.2% vs. 4.6%, $P = 0.008$) and both birth-related and socioeconomic factors (3.6% vs. 4.6%, $P < 0.001$), the proportion of preterm birth remained significantly lower in the immigrant group (Table 5).

(2) Low birth weight

The proportion of low birth weight was significantly lower in the Chinese group (3.0% vs. 3.7%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (2.8% vs. 3.6%, $P < 0.001$) and after adjusting for birth-related and socioeconomic factors (2.4% vs. 3.6%, $P < 0.001$) (Table 5).

(3) Small for gestational age in term infants

The proportion of low birth weight was significantly lower in the Chinese group (5.2% vs. 6.1%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (4.5% vs. 5.7%, $P < 0.001$) and after adjusting for birth-related and socioeconomic factors (4.1% vs. 5.7%, $P < 0.001$) (Table 5).

Table 5. Analyses of adverse birth outcomes among Korean natives and immigrant women from China

	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants from China (%)	*P*-value	Native Koreans (%)	Immigrants from China (%)	*P*-value	Native Koreans (%)	Immigrants from China (%)	*P*-value
Preterm birth	4.7	4.2	0.004	4.6	4.2	0.008	4.5	3.6	<0.001
Low birth weight	3.7	3.0	<0.001	3.6	2.8	<0.001	3.6	2.4	<0.001
SGA in term infants	6.1	5.2	<0.001	5.7	4.5	<0.001	5.7	4.1	<0.001

a. Adjusted for infant sex, maternal age, marriage status, and parity

b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

SGA: Small for gestational age in term infants

3) Southeast Asia

(1) Preterm birth

The proportion of preterm birth in the immigrant women from Southeast Asia was significantly higher than that in the native Korean group (5.1% vs. 4.7%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (5.4% vs. 4.6%, $P < 0.001$). However, after adjusting for birth-related and socioeconomic factors, preterm birth was more prevalent in the native Korean group (4.6% vs. 4.2%, $P < 0.001$) (Table 6).

(2) Low birth weight

The proportion of low birth weight was significantly higher in the immigrant group (4.8% vs. 3.7%, $P < 0.001$), and a similar result was observed after adjusting for birth-related factors (4.9% vs. 3.6%, $P < 0.001$). The trend was similar though it was not significant when adjusted for birth-related and socioeconomic factors (3.7% vs. 3.6%, $P = 0.172$) (Table 6).

(3) Small for gestational age in term infants

The proportion of SGA was significantly higher in the immigrant group (9.3% vs. 6.1%, $P < 0.001$), and similar results were observed after adjusting for birth-related factors (8.3% vs. 5.7%, $P < 0.001$), and birth-related and socioeconomic factors (7.2% vs. 5.7%, $P < 0.001$) (Table 6).

Table 6. Analyses of adverse birth outcomes among Korean natives and immigrant women from Southeast Asia

	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants from SE Asia (%)	*P*-value	Native Koreans (%)	Immigrants from SE Asia (%)	*P*-value	Native Koreans (%)	Immigrants from SE Asia (%)	*P*-value
Preterm birth	4.7	5.1	<0.001	4.6	5.4	<0.001	4.6	4.2	<0.001
Low birth weight	3.7	4.8	<0.001	3.6	4.9	<0.001	3.6	3.7	0.172
SGA in term infants	6.1	9.3	<0.001	5.7	8.3	<0.001	5.7	7.2	<0.001

a. Adjusted for infant sex, maternal age, marriage status, and parity

b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

SGA: Small for gestational age, SE: Southeast

4) Europe

(1) Preterm birth

The proportion of preterm birth in the immigrant women from European countries was lower than the native group though it was not significant (4.3% vs. 4.7%, P = 0.503). The results showed similar trend after adjusting for the birth-related factors (4.4% vs. 4.6%, P = 0.655), and adjusting for birth-related and socioeconomic factors (4.0% vs. 4.5%, P = 0.229) (Table 7).

(2) Low birth weight

The proportion of low birth weight in the immigrants group was not significantly different from that of the natives group (3.7% vs. 3.7%, P = 0.987), and a similar result was observed after adjusting for birth-related factors (3.7% vs. 3.6%, P = 0.828), and after adjusting for birth-related and socioeconomic factors (3.4% vs. 3.6%, P = 0.638) (Table 7).

(3) Small for gestational age in term infants

The proportion of SGA in the immigrants group was not significantly different from that of the natives group (5.8% vs. 6.1%, P = 0.609), and a similar result was observed after adjusting for birth-related factors (5.4% vs. 5.7%, P = 0.617), and after adjusting for birth-related and socioeconomic factors (5.2% vs. 5.7%, P = 0.413) (Table 7).

Table 7. Analyses of adverse birth outcomes among Korean natives and immigrant women from Europe

	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants from Europe (%)	*P*-value	Native Koreans (%)	Immigrants from Europe (%)	*P*-value	Native Koreans (%)	Immigrants from Europe (%)	*P*-value
Preterm birth	4.7	4.3	0.503	4.6	4.4	0.655	4.5	4.0	0.229
Low birth weight	3.7	3.7	0.987	3.6	3.7	0.828	3.6	3.4	0.638
SGA in term infants	6.1	5.8	0.609	5.7	5.4	0.617	5.7	5.2	0.413

a. Adjusted for infant sex, maternal age, marriage status, and parity

b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

SGA: Small for gestational age in term infants

5) America

(1) Preterm birth

The proportion of preterm birth in the immigrant women from American countries was not significantly different, compared to the native group (4.6% vs. 4.7%, P = 0.881). The results were similar after adjusting for the birth-related factors (4.5% vs. 4.6%, P = 0.933), and adjusting for birth-related and socioeconomic factors (4.8 vs. 4.5%, P = 0.615) (Table 8).

(2) Low birth weight

The proportion of low birth weight in the immigrant women from American countries was not significantly different from that of the natives group (3.7% vs. 3.7%, P = 0.934), and a similar result was observed after adjusting for birth-related factors (3.5% vs. 3.6%, P = 0.715), and after adjusting for birth-related and socioeconomic factors (3.7% vs. 3.6%, P = 0.854) (Table 8).

(3) Small for gestational age in term infants

The proportion of SGA in the immigrants group was not significantly different from that of the natives group (5.9% vs. 6.1%, P = 0.685), and a similar result was observed after adjusting for birth-related factors (5.0% vs. 5.7%, P = 0.202), and after adjusting for birth-related and socioeconomic factors (5.2% vs. 5.7%, P = 0.368) (Table 8).

Table 8. Analyses of adverse birth outcomes among Korean natives and immigrant women from America

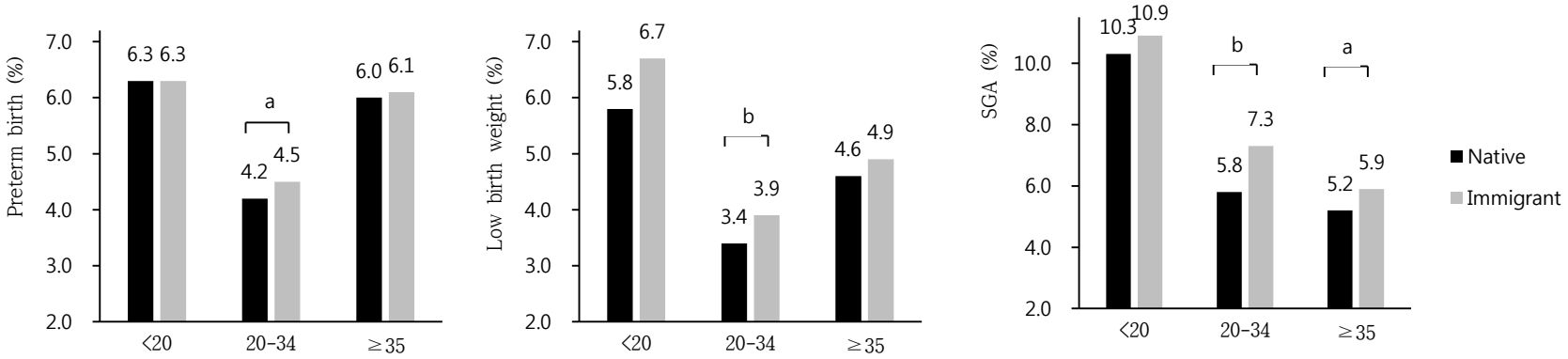
	Model 1 (no adjustment)			Model 2 [a] (adjusted for birth-related factors)			Model 3 [b] (model 2 + socioeconomic factors)		
	Native Koreans (%)	Immigrants from America (%)	*P*-value	Native Koreans (%)	Immigrants from America (%)	*P*-value	Native Koreans (%)	Immigrants from America (%)	*P*-value
Preterm birth	4.7	4.6	0.881	4.6	4.5	0.933	4.5	4.8	0.615
Low birth weight	3.7	3.7	0.934	3.6	3.5	0.715	3.6	3.7	0.854
SGA in term infants	6.1	5.9	0.685	5.7	5.0	0.202	5.7	5.2	0.368

a. Adjusted for infant sex, maternal age, marriage status, and parity
b. Adjusted for infant sex, maternal age, marriage status, parity, area of birth, parental education level, and parental occupation

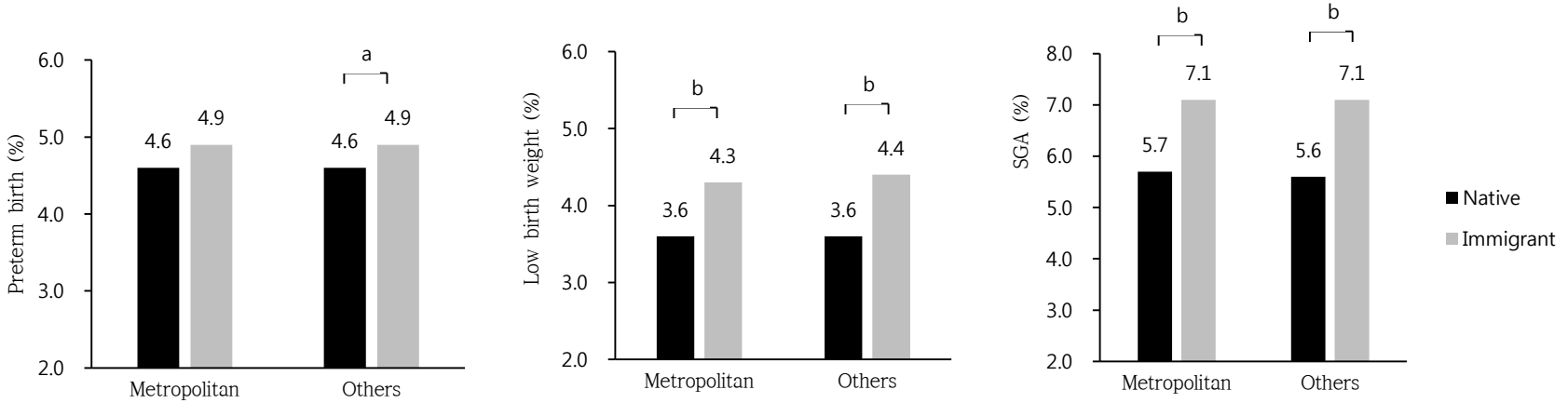
SGA: Small for gestational age in term infants

E. Subgroup analysis according to demographic characteristics

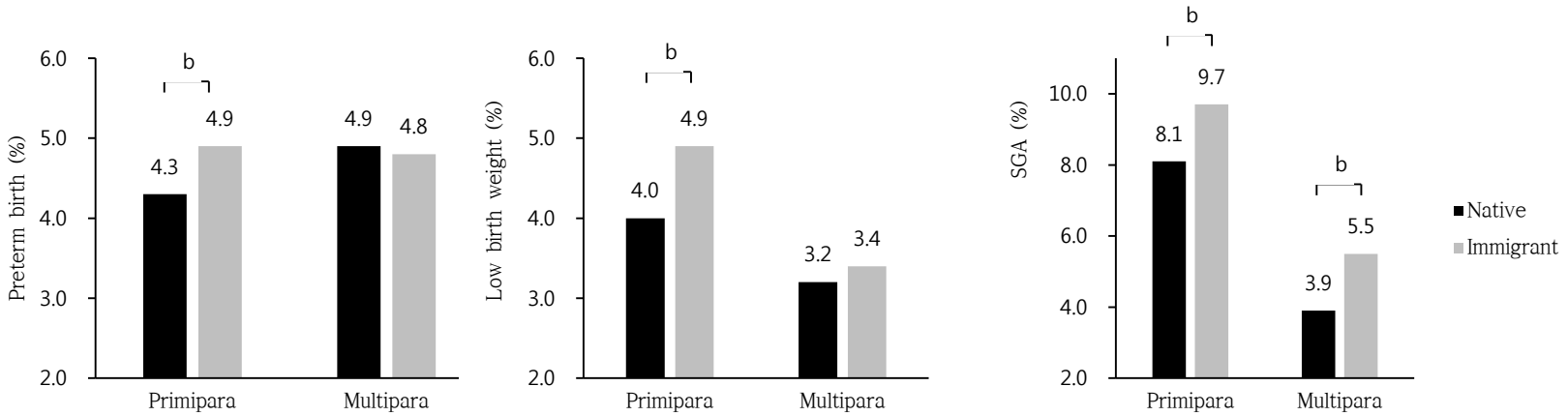
After adjusting for birth-related factors, the proportions of preterm birth and low birth weight were not significant different for women who were <20 years old or ≥35 years old. However, among women who were 20–34 years old, both proportions were significantly higher in the immigrant group (preterm birth: 4.5% vs. 4.2%, P = 0.003; low birth weight: 3.9% vs. 3.4%, P < 0.001). The proportions of SGA were significantly higher among women in the immigrant groups who were aged 20 and over. When the adjusted proportions of birth outcomes were compared according to region, the immigrant group had higher proportions of preterm birth, low birth weight, and SGA for both metropolitan cities and other areas. Analyses according to parity revealed that the proportions of preterm birth and low birth weight were higher in the primipara immigrant group (preterm birth: 4.9% vs. 4.3%, P < 0.001; low birth weight: 4.9% vs. 4.0%, P < 0.001), although there were no significant differences among multipara mothers (preterm birth: 4.8% vs. 4.9%, P = 0.370; low birth weight: 3.4% vs. 3.2%, P = 0.190). However, the proportions of SGA were significantly higher both in the primipara and multipara immigrant group (Fig. 2).



(a) Analysis according to maternal age



(b) Analysis according to area of birth

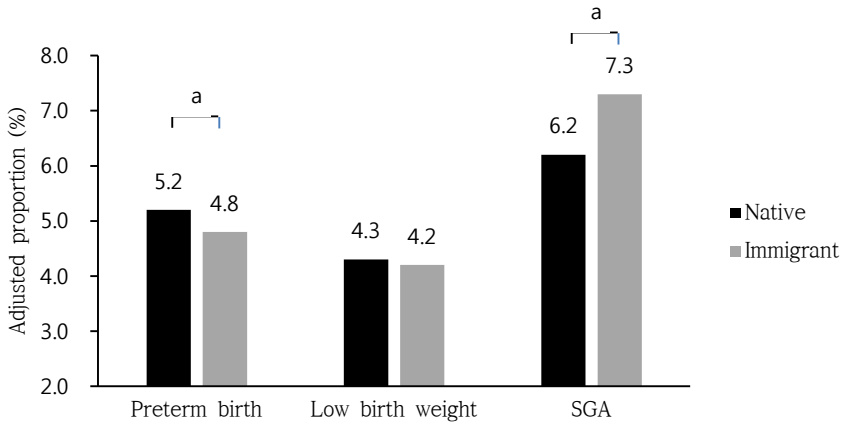


(C) Analysis according to parity

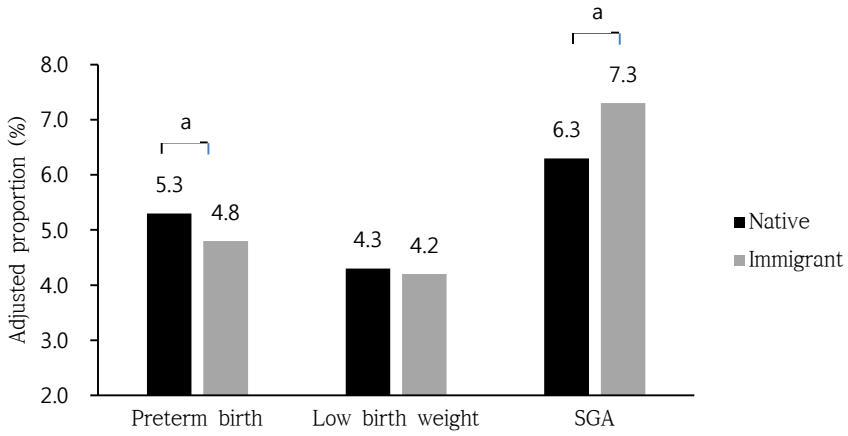
Fig. 2. Subgroup analyses of preterm births and low birth weight infants among immigrant and native women in Korea (adjusted for infant sex, maternal age, marriage status, and parity). a: $p < 0.05$, b: $p < 0.001$, SGA: small for gestational age in term infants

F. Comparing outcomes among vulnerable populations

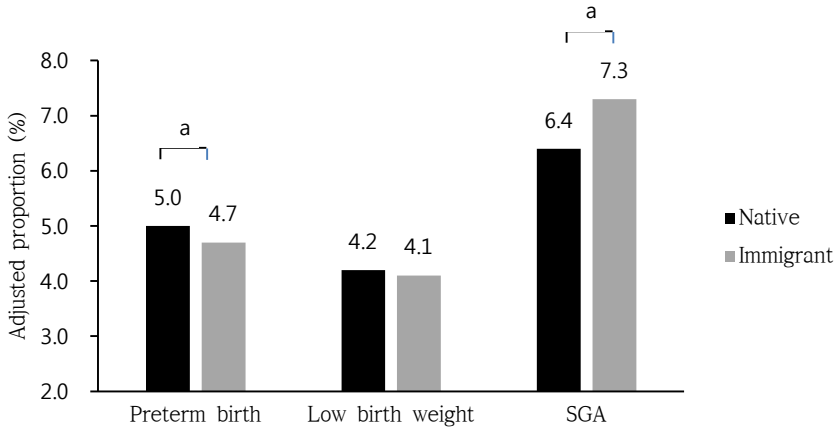
When the birth outcomes of immigrants and vulnerable native Koreans (low maternal or paternal education, or paternal unemployment) were compared, similar findings were observed for all three analyses. The proportions of preterm birth were higher among the vulnerable native Koreans, and the proportions of SGA were higher among the immigrant group, although the proportions of low birth weight were similar for immigrants and vulnerable native Koreans (Fig. 3). In subgroup analyses for immigrants from Southeast Asia, the results show that the proportion of preterm birth was not different but the proportions of low birth weight and SGA were significantly higher in the immigrant group for all three analyses (Fig. 4).



(a) Compared to less educated fathers in the native group



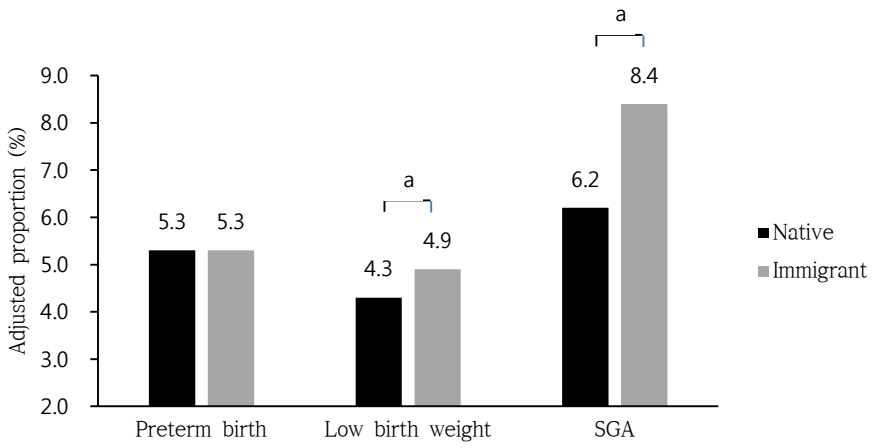
(b) Compared to less educated mothers in the native group



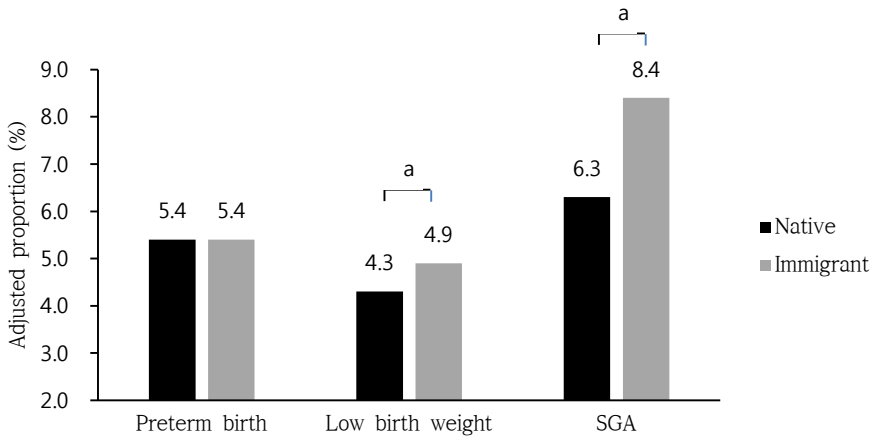
(c) Compared to unemployed fathers in the native group

Fig. 3. Adjusted proportion of adverse birth outcomes among immigrants and vulnerable native Koreans in Korea.

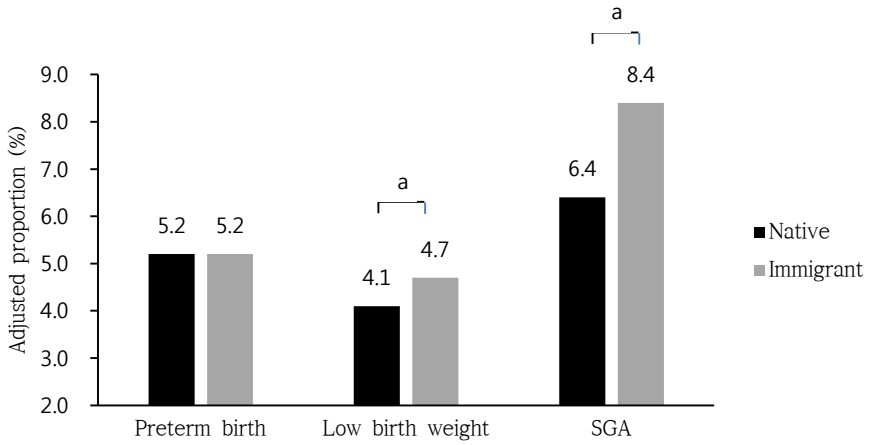
a: $p < 0.001$, SGA: small for gestational age in term infants



(a) Compared to less educated fathers in the native group



(b) Compared to less educated mothers in the native group



(c) Compared to unemployed fathers in the native group

Fig. 4. Adjusted proportion of adverse birth outcomes among immigrants from Southeast Asia and vulnerable native Koreans in Korea.

a: $p < 0.001$, , SGA: small for gestational age in term infants

G. Factors that were associated with adverse birth outcomes

1) Frequency of adverse birth outcome by individual-level characteristics

Table 9 shows crude data of proportion of adverse birth outcomes according to demographic factors. The proportions of preterm birth and SGA were higher in male than female. Preterm births were more frequently occurred among the native group in less educated parents, compared to the immigrant group, otherwise those were higher in the immigrants group in parents who graduated college or higher, compared to the native group. In contrast, among less educated parent, proportions of low birth weight and SGA were similar or higher in the immigrant group than the native group. Both native and immigrant group showed higher proportion of adverse birth outcomes from fathers who were blue-collar workers or unemployed, compared to other father's occupations. All adverse birth outcomes were more likely to occur from immigrant mothers who came from low and lower-middle countries.

Table 9. Frequency of adverse birth outcomes by individual-level characteristics in Korea, 2010-2013

	Preterm birth		Low birth weight		SGA	
	Natives n (%)	Immigrants n (%)	Natives n (%)	Immigrants n (%)	Natives n (%)	Immigrants n (%)
Infant sex						
Female	33,321 (4.1)	1,352 (4.1)	32,233 (4.0)	1,500 (4.5)	39,728 (5.1)	2,139 (6.7)
Male	43,140 (5.1)	1,876 (5.4)	28,424 (3.4)	1,367 (3.9)	55,895 (7.0)	3,099 (9.4)
Marital status						
Married	74,914 (4.6)	3,196 (4.7)	59,312 (3.7)	2,843 (4.2)	93,834 (6.1)	5,207 (8.1)
Unmarried	1,547 (7.2)	32 (7.5)	1,345 (6.2)	24 (5.6)	1,789 (8.9)	31 (7.8)
Paternal age (years)						
< 20	219 (8.1)	0 (0.0)	189 (7.0)	1 (14.3)	274 (11.1)	2 (28.5)
20 – 29	11,275 (4.3)	87 (3.4)	9,284 (3.5)	80 (3.2)	17,737 (7.1)	194 (7.9)
30 – 39	56,113 (4.5)	1,383 (4.6)	44,403 (3.6)	1,227 (4.1)	70,231 (5.9)	2,268 (7.9)
≥ 40	8,766 (6.5)	1,739 (5.0)	6,705 (5.0)	1,544 (4.4)	7,289 (5.8)	2,754 (8.2)
Maternal age (years)						
< 20	447 (7.3)	136 (5.4)	390 (6.3)	147 (5.8)	606 (10.6)	258 (10.8)
20 – 34	57,859 (4.3)	2,663 (4.6)	46,133 (3.5)	2,353 (4.0)	79,130 (6.2)	4,513 (8.1)
≥ 35	18,150 (6.0)	425 (6.1)	14,132 (4.7)	363 (5.2)	15,876 (5.6)	463 (7.1)
Parity						
Primiparous	36,634 (4.4)	1,983 (4.8)	34,215 (4.1)	1,989 (4.8)	65,589 (8.2)	3,839 (9.7)
Multiparous	39,757 (5.0)	1,241 (4.7)	26,396 (3.3)	874 (3.3)	29,948 (3.9)	1,394 (5.5)
Area of birth						
Metropolitan	33,667 (4.7)	1,124 (5.0)	26,972 (3.6)	1,025 (4.1)	42874 (6.2)	1,819 (8.1)
Others	42,804 (4.4)	2,104 (4.3)	33,685 (3.5)	1,842 (3.9)	52749 (6.0)	3,419 (8.1)
Place of birth						
Hospital	75,156 (4.6)	3,174 (4.7)	59,715 (3.7)	2,825 (4.2)	1,925 (8.0)	5,156 (8.1)
Others	1,271 (5.0)	51 (5.1)	919 (3.6)	41 (4.1)	93,663 (6.1)	78 (8.3)

a. Unemployed: unemployed, housewife, or student

SGA: small for gestational age in term infants

Table 9. Frequency of adverse birth outcomes by individual-level characteristics in Korea, 2010-2013 (continued)

	Preterm birth		Low birth weight		SGA	
	Natives n (%)	Immigrants n (%)	Natives n (%)	Immigrants n (%)	Natives n (%)	Immigrants n (%)
Paternal education						
High school or below	24,696 (5.5)	2,152 (4.8)	19,547 (4.4)	1,966 (4.4)	27,110 (6.4)	3,598 (8.4)
College or higher	51,577 (4.3)	1,049 (4.7)	40,958 (3.4)	879 (3.9)	68,308 (6.0)	1,606 (7.5)
Maternal education						
High school or below	25,843 (5.6)	2,319 (4.8)	20,334 (4.4)	2,110 (4.4)	27,686 (6.4)	3,870 (8.4)
College or higher	50,477 (4.3)	884 (4.7)	40,208 (3.4)	736 (3.9)	67,772 (6.0)	1,317 (7.3)
Paternal job						
Manager / specialist	20,351 (4.4)	508 (4.8)	16,105 (3.5)	414 (3.9)	26,351 (6.0)	745 (7.4)
Clerical worker	25,267 (4.4)	598 (4.6)	20,246 (3.6)	511 (4.0)	32,968 (6.1)	934 (7.6)
Service worker	13,590 (4.8)	561 (4.6)	10,651 (3.8)	475 (3.9)	16,443 (6.1)	938 (8.0)
Blue-collar	14,039 (5.2)	1,380 (4.9)	11,012 (4.1)	1,284 (4.5)	15,838 (6.2)	2,297 (8.5)
Unemployed [a]	3,214 (5.3)	181 (4.7)	2,643 (4.3)	183 (4.7)	4,023 (7.0)	324 (8.8)
Maternal job						
Manager / specialist	9,202 (4.2)	89 (5.0)	7,455 (3.4)	70 (3.9)	12,802 (6.2)	124 (7.3)
Clerical workers	10,202 (4.2)	66 (4.8)	8,377 (3.5)	40 (2.9)	14,505 (6.3)	78 (5.9)
Service workers	3,550 (4.7)	57 (5.5)	2,760 (3.6)	41 (4.0)	4,413 (6.1)	78 (8.0)
Blue-collar	1,402 (4.9)	127 (3.9)	1,045 (3.7)	133 (4.1)	1,709 (6.3)	267 (8.6)
Unemployed [a]	52,105 (4.8)	2,889 (4.8)	41,020 (3.8)	2,583 (4.3)	62,194 (6.0)	4,691 (8.1)
Maternal country						
High and upper-middle		1,110 (4.3)		848 (3.3)		1,533 (6.2)
Low and lower-middle		2,104 (5.0)		2,008 (4.8)		3,684 (9.2)

a. Unemployed: unemployed, housewife, or student

SGA: small for gestational age in term infants

2) Multivariate analysis for the immigrants group

Multivariate analyses revealed that male infants had a higher risk of preterm birth (OR: 1.36; 95% CI: 1.27–1.46), SGA (OR: 1.45; 95% CI: 1.37–1.54) and a lower risk of low birth weight (OR: 0.87; 95% CI: 0.80–0.94). Older maternal age (≥35 years) was a risk factor for preterm birth (OR: 1.49; 95% CI: 1.32–1.67), low birth weight (OR: 1.71; 95% CI: 1.50–1.93) and SGA (OR: 1.16; 95% CI: 1.04–1.29), and multipara women exhibited a 33% lower risk of low birth weight and a 46% lower risk of SGA, compared to primipara women. Immigrant women from low-/lower-middle-income countries had a 28% higher risk of preterm birth, a 60% higher risk of low birth weight and a 54% higher risk of SGA, compared to immigrants from high-/upper-middle-income countries. Parental education level or occupation did not affect the risks of preterm birth or low birth weight in the immigrant group (Table 10).

Table 10. Multivariate analysis for factors associated with adverse birth outcomes among immigrant women in Korea

	Preterm birth (aOR, 95% CI)	Low birth weight (aOR, 95% CI)	Small for gestational age (aOR, 95% CI)
Infant sex			
Female	1.0 (reference)	1.0 (reference)	1.0 (reference)
Male	1.36 (1.27-1.46)[b]	0.87 (0.80-0.94)[b]	1.45 (1.37-1.54)[b]
Marital status			
Married	1.0 (reference)	1.0 (reference)	1.0 (reference)
Unmarried	1.11 (0.57-2.19)	0.97 (0.45-2.09)	0.97 (0.76-1.23)
Paternal age (years)			
< 20	0	4.10 (0.47-35.44)	4.92 (0.93-26.22)
20 - 29	0.81 (0.65-1.02)	0.87 (0.69-1.10)	1.05 (0.90-1.23)
30 - 39	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 40	1.03 (0.95-1.11)	0.98 (0.91-1.07)	0.98 (0.92-1.05)
Maternal age (years)			
< 20	1.08 (0.90-1.30)	1.13 (0.95-1.35)	0.99 (0.86-1.13)
20 - 34	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 35	1.49 (1.32-1.67)[b]	1.71 (1.50-1.93)[b]	1.16 (1.04-1.29)[a]
Parity			
Primiparous	1.0 (reference)	1.0 (reference)	1.0 (reference)
Multiparous	0.96 (0.89-1.03)	0.67 (0.61-0.72)[b]	0.54 (0.51-0.58)[b]
Area of birth			
Metropolitan	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	1.00 (0.93-1.08)	0.94 (0.87-1.02)	0.97 (0.92-1.04)
Place of birth			
Hospital	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.96 (0.71-1.28)	1.05 (0.76-1.45)	0.97 (0.76-1.23)
Paternal education			
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	1.04 (0.95-1.14)	1.01 (0.92-1.11)	0.99 (0.93-1.07)
Maternal education			
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	1.02 (0.93-1.12)	1.04 (0.94-1.15)	1.01 (0.93-1.09)
Paternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	0.97 (0.86-1.10)	1.04 (0.91-1.19)	1.04 (0.94-1.15)
Service worker	0.94 (0.83-1.10)	0.95 (0.83-1.10)	1.04 (0.94-1.16)
Blue-collar	1.00 (0.89-1.12)	1.09 (0.96-1.24)	1.08 (0.98-1.18)
Unemployed [c]	0.97 (0.81-1.16)	1.16 (0.97-1.40)	1.12 (0.97-1.29)
Maternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	1.03 (0.74-1.45)	0.74 (0.49-1.11)	0.76 (0.56-1.03)
Service workers	1.12 (0.79-1.61)	1.02 (0.68-1.53)	0.97 (0.71-1.31)
Blue-collar	0.72 (0.53-0.97)[a]	0.88 (0.64-1.21)	0.98 (0.77-1.25)
Unemployed [c]	0.93 (0.74-1.17)	0.95 (0.73-1.23)	0.91 (0.74-1.10)
Maternal country			
High and upper-middle income	1.0 (reference)	1.0 (reference)	1.0 (reference)
Low and lower-middle income	1.28 (1.17-1.40)[b]	1.60 (1.45-1.76)[b]	1.54 (1.43-1.66)[b]

a. $p < 0.05$, b. $p < 0.001$, c. Unemployed: unemployed, housewife, or student

3) Multivariate analysis for the natives group

Multivariate analyses revealed that male infants had a higher risk of preterm birth (OR: 1.26; 95% CI: 1.24–1.28) and SGA (OR: 1.40; 95% CI: 1.38-1.42), and a lower risk of low birth weight (OR: 0.84; 95% CI: 0.83–0.86). Infants in unmarried couples had higher risks of preterm birth (OR: 1.33; 95% CI: 1.26-1.41), low birth weight (OR: 1.37; 95% CI: 1.29-1.45) and SGA (OR: 1.17; 95% CI: 1.11-1.24). Younger paternal age (<20 years) was a risk factor for preterm birth (OR: 1.21; 95% CI: 1.01-1.44), but it was not a risk factor for low birth weight and SGA. Paternal age from 20 to 29 had lower risk of all adverse birth outcomes while aged 40 and over had higher risks, compared to age from 30 to 39. Both younger (<20 years) and older maternal age (≥35 years) were risk factors for preterm birth, low birth weight and SGA. Multipara women exhibited a 5% higher risk of preterm birth, and a 28% and a 56% lower risk of low birth weight and SGA, compared to primipara women. Babies who were born in other places than hospitals had higher risk of low birth weight (OR: 1.08; 95% CI: 1.01-1.15) and lower risk of SGA (OR: 0.73; 95% CI: 0.70-0.77). Parents with higher educational level (college or higher) had lower risks of preterm birth, low birth weight and SGA. Blue-collar worker fathers had a 7% higher risk of preterm birth and a 8% higher risk of low birth weight, and unemployed fathers had a 10% higher risk of preterm birth, a 13% of low birth weight and a 9% of SGA. Unemployed mothers had a 4% higher risk of low birth weight and SGA but blue-collar worker mothers had a 9% lower risk of low birth weight (Table 11).

Table 11. Multivariate analysis for factors associated with adverse birth outcomes among native women in Korea

	Preterm birth (aOR, 95% CI)	Low birth weight (aOR, 95% CI)	Small for gestational age (aOR, 95% CI)
Infant sex			
Female	1.0 (reference)	1.0 (reference)	1.0 (reference)
Male	1.26 (1.24-1.28)[b]	0.84 (0.83-0.86)[b]	1.40 (1.38-1.42)[b]
Marital status			
Married	1.0 (reference)	1.0 (reference)	1.0 (reference)
Unmarried	1.33 (1.26-1.41)[b]	1.37 (1.29-1.45)[b]	1.17 (1.11-1.24)[b]
Paternal age (years)			
< 20	1.14 (0.96-1.34)	1.02 (0.85-1.24)	1.02 (0.88-1.19)
20 - 29	0.95 (0.93-0.97)[b]	0.90 (0.88-0.93)[b]	0.98 (0.96-1.00)
30 - 39	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 40	1.20 (1.17-1.23)[b]	1.19 (1.15-1.23)[b]	1.06 (1.04-1.10)[b]
Maternal age (years)			
< 20	1.17 (1.03-1.33)[a]	1.15 (1.01-1.32)[a]	1.12 (1.01-1.25)[a]
20 - 34	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 35	1.27 (1.25-1.30)[b]	1.35 (1.32-1.38)[b]	1.06 (1.04-1.09)[b]
Parity			
Primiparous	1.0 (reference)	1.0 (reference)	1.0 (reference)
Multiparous	1.05 (1.03-1.07)[b]	0.72 (0.71-0.73)[b]	0.44 (0.44-0.45)[b]
Area of birth			
Metropolitan	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.98 (0.97-1.00)	0.98 (0.97-1.00)	1.0 (0.98-1.01)
Place of birth			
Hospital	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.97 (0.91-1.02)	1.08 (1.01-1.15)[a]	0.73 (0.70-0.77)[b]
Paternal education			
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	0.88 (0.87-0.89)[b]	0.87 (0.85-0.89)[b]	0.94 (0.92-0.95)[b]
Maternal education			
High school and below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	0.84 (0.82-0.85)[b]	0.83 (0.81-0.84)[b]	0.91 (0.89-0.92)[b]
Paternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	1.01 (0.99-1.03)	1.03 (1.01-1.05)[a]	1.02 (1.00-1.04)[a]
Service worker	1.01 (0.99-1.04)	1.01 (0.98-1.04)	1.01 (0.98-1.03)
Blue-collar	1.07 (1.05-1.10)[b]	1.08 (1.05-1.11)[b]	1.01 (0.99-1.04)
Unemployed [c]	1.10 (1.07-1.14)[b]	1.13 (1.08-1.18)[b]	1.09 (1.05-1.13)[b]
Maternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	0.98 (0.95-1.01)	0.98 (0.95-1.02)	1.00 (0.97-1.03)
Service workers	1.02 (0.98-1.06)	0.98 (0.93-1.02)	0.97 (0.93-1.00)
Blue-collar	0.97 (0.92-1.03)	0.91 (0.85-0.98)[a]	1.00 (0.95-1.06)
Unemployed [c]	1.02 (1.00-1.05)	1.04 (1.01-1.06)[a]	1.04 (1.02-1.06)[b]

a. $p < 0.05$

b. $p < 0.001$

c. Unemployed: unemployed, housewife, or student

4) Multivariate analysis for all births

Table 12 shows multivariate logistic regression for all births in Korea during 2010 to 2013. After adjustment with whole factors, immigrant women, regardless of economic status of their homeland, had lower risks of preterm birth and low birth weight. Immigrants from high and upper-middle income countries had a 9% lower risk of SGA while those from low and lower-middle income countries had a 28% higher risk of SGA. And the results revealed that male infants had a higher risk of preterm birth (OR: 1.26; 95% CI: 1.24–1.28) and SGA (OR: 1.40; 95% CI: 1.38-1.42), and a lower risk of low birth weight (OR: 0.84; 95% CI: 0.83–0.86). Infants in unmarried couples had higher risks of three of the adverse birth outcomes. Younger paternal age (<20 years) was a risk factor for preterm birth (OR: 1.21; 95% CI: 1.03-1.43), but it was not a risk factor for low birth weight and SGA. Paternal age from 20 to 29 had lower risk of preterm birth, low birth weight and SGA while aged 40 and over had higher risk of preterm birth, low birth weight and SGA, compared to age from 30 to 39. Both younger (<20 years) and older maternal age (≥35 years) were risk factors for adverse birth outcomes. Multipara women exhibited a 5% higher risk of preterm birth, a 28% lower risk of low birth weight and a 55% lower risk of SGA, compared to primipara women. Babies who were born in other places than hospitals had higher risk of low birth weight (OR: 1.07; 95% CI: 1.01-1.15) and lower risk of SGA (OR: 0.74; 95% CI: 0.71-0.78). Parents with higher educational level (college or higher) had lower risks of adverse birth outcomes, compared to less educated parents (high school or below). Blue-collar worker fathers had a 7% higher risk of preterm birth and a 8% higher risk of low birth weight, and unemployed fathers had a 9% higher risk of preterm birth, a 13% of low birth weight and a 10% of SGA. Unemployed mothers had a 4% higher risk of low birth weight and SGA (Table 12).

Table 12. Multivariate analysis for factors associated with adverse birth outcomes infants in Korea

	Preterm birth (aOR, 95% CI)	Low birth weight (aOR, 95% CI)	Small for gestational age (aOR, 95% CI)
Maternal country			
Natives	1.0 (reference)	1.0 (reference)	1.0 (reference)
High and upper-middle	0.81 (0.76-0.86)[b]	0.75 (0.70-0.80)[b]	0.91 (0.86-0.96)[b]
Low and lower-middle	0.86 (0.81-0.90)[b]	0.99 (0.94-1.04)	1.28 (1.23-1.33)[b]
Infant sex			
Female	1.0 (reference)	1.0 (reference)	1.0 (reference)
Male	1.26 (1.24-1.28)[b]	0.84 (0.83-0.86)[b]	1.40 (1.38-1.42)[b]
Marital status			
Married	1.0 (reference)	1.0 (reference)	1.0 (reference)
Unmarried	1.34 (1.26-1.42)[b]	1.36 (1.28-1.45)[b]	1.17 (1.11-1.24)[b]
Paternal age (years)			
< 20	1.15 (0.98-1.36)	1.03 (0.87-1.23)	1.05 (0.91-1.22)
20 - 29	0.95 (0.93-0.97)[b]	0.90 (0.88-0.93)[b]	0.98 (0.96-1.00)[a]
30 - 39	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 40	1.17 (1.15-1.20)[b]	1.16 (1.13-1.19)[b]	1.07 (1.04-1.10)[b]
Maternal age (years)			
< 20	1.17 (1.05-1.30)[a]	1.19 (1.07-1.33)[a]	1.10 (1.01-1.19)[a]
20 - 34	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥ 35	1.29 (1.26-1.31)[b]	1.36 (1.33-1.39)[b]	1.06 (1.04-1.08)[b]
Parity			
Primiparous	1.0 (reference)	1.0 (reference)	1.0 (reference)
Multiparous	1.05 (1.03-1.06)[b]	0.72 (0.71-0.73)[b]	0.45 (0.44-0.45)[b]
Area of birth			
Metropolitan	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.98 (0.97-1.00)	0.98 (0.97-1.00)	1.00 (0.98-1.01)
Place of birth			
Hospital	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.97 (0.91-1.02)	1.07 (1.01-1.15)[a]	0.74 (0.71-0.78)[b]
Paternal education			
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	0.89 (0.87-0.90)[b]	0.87 (0.86-0.89)[b]	0.94 (0.92-0.95)[b]
Maternal education			
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)
College or higher	0.84 (0.83-0.86)[b]	0.83 (0.81-0.85)[b]	0.91 (0.89-0.92)[b]
Paternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical worker	1.01 (0.99-1.03)	1.03 (1.01-1.05)[a]	1.02 (1.00-1.04)[a]
Service worker	1.01 (0.99-1.04)	1.01 (0.98-1.03)	1.01 (0.99-1.03)
Blue-collar	1.07 (1.04-1.09)[b]	1.08 (1.05-1.11)[b]	1.02 (1.00-1.04)
Unemployed [c]	1.09 (1.05-1.14)[b]	1.13 (1.08-1.18)[b]	1.10 (1.06-1.13)[b]
Maternal job			
Manager / specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	0.98 (0.95-1.01)	0.98 (0.95-1.01)	1.00 (0.97-1.02)
Service workers	1.02 (0.98-1.07)	0.98 (0.94-1.03)	0.97 (0.93-1.00)
Blue-collar	0.96 (0.92-1.01)	0.92 (0.86-0.98)[a]	1.02 (0.96-1.07)
Unemployed [c]	1.02 (1.00-1.05)	1.04 (1.01-1.06)[a]	1.04 (1.02-1.06)[b]

a. $p < 0.05$, b. $p < 0.001$, c. Unemployed: unemployed, housewife, or student

V. Discussion and Conclusion

This report aimed to describe the proportions of preterm birth, low birth weight and SGA among immigrant women in Korea, and to compare these outcomes to those among native Korean women, in order to evaluate the disparities in perinatal health among immigrant and native women.

A. Demographic characteristics of the study population

These demographic data revealed that, compared to the native Korean group, the immigrant group had an older mean paternal age and a younger mean maternal age. Moreover, the immigrant group had a lower parental education level and a higher proportion of blue-collar workers. Given the rapid economic growth in Korea, rapid urbanization has led young women to frequently move to cities for better education and job opportunities. However, men in rural areas typically stay on family-owned farms, and this phenomenon makes it difficult for rural men to find marriage partners. Therefore, rural men have started looking to other countries for these partners, which led to the rate of international marriage increasing by approximately ten-fold since 1990; these marriages accounted for approximately 10% of all marriages in 2010 (Kim, 2009; Lee et al., 2012). These factors likely explain the findings that immigrant women were married to older men who were less education and more likely to be more blue-collar workers.

B. Correlation among variables

According to correlation tests, socioeconomic factors showed very weak correlation with adverse birth outcomes. These birth outcomes are known to be increased with socioeconomic disadvantages but it is often steepest at the lowest level of the social

grade rather than linear correlation (Kramer et al., 2000). Furthermore, previous studies reported selection bias in immigrant group that usually less educated people immigrate, thus this homogeneity lessening the educational gradient in health (Auger et al. 2008; Janevic et al. 2001). For this reason, these variables showed very weak correlation even though some variables had higher risks of adverse birth outcomes. Absolute values of correlation test between socioeconomic factors in the immigrant group were smaller than those of the native group. According to the previous studies, most immigrant women migrated to Korea for economic problems and became housewives. Therefore, 47% of them were unemployment state (mostly, housewives) and even 89% of immigrant women were unemployed in this study. Among employed immigrant women, 54.4% were blue-collar workers and their jobs were not related to their educational level. Janevic et al. explained this phenomenon as 'occupational downgrading' that immigrants have limited chance to get job compared to native-born with the same educational level and suffer from a loss of social status (Janevic et al., 2011). Furthermore, most immigrant women, especially from Vietnam, chose their spouse through marriage brokers and 67.2% are blue-collar workers (Kim, 2011; Korean Women's Development Institute, 2013). For these reasons, correlation between socioeconomic factors in the immigrant group may be weaker than the native group.

C. Adverse birth outcomes among immigrant women in Korea

After adjusting for birth-related factors (model 2), the proportions of preterm birth, low birth weight and SGA were noticeably higher in the immigrant group. In this context, most mothers in the immigrant group were from Asian countries, and previous studies have suggested that Asian mothers experience adverse birth outcomes relatively frequently (Gagnon et al., 2009; Urquia et al., 2015). In addition,

many of these mothers are from low socioeconomic groups in low-/low-middle-income countries (Ryu & Kim, 2013). These factors might affect the mothers' pre-pregnancy health and lead to them being underweight or having poor food intake, which might result in poor birth outcomes (Kim, 2009; Kliegman, 2012; Martin et al., 2014). However, after adjusting for socioeconomic factors (model 3; parental occupation, education level, and birth region), the proportions of preterm birth and low birth weight were higher in the native Korean group. This finding might indicate that these socioeconomic factors affected the higher proportions of adverse birth outcomes in the immigrant group that were observed in model 2 (Table 3) as previous studies (Parker, Schoendorf, & Kiely, 1994; Shin et al., 2012; Hanke et al. 2001). This finding also can be interpreted into the healthy migrant effect may apply to immigrant women in Korea. In the immigrant group, marriage based immigrant women comprise a large proportion thus they might be young and healthy enough to be chosen by their Korean spouses. For this reason, after adjusting socioeconomic effect, the birth outcomes were better or similar in the immigrant group, compared to the natives. Through these two results, health status of immigrant women can be interpreted in opposite way, however, it was impossible to know health status of immigrant women in this study, further researches are needed.

Interestingly, the proportion of SGA was higher in the immigrant group (Table 3). Higher SGA rates in immigrant group have been reported in the previous studies, such as among Blacks in the US, aborigines in Australia, Asians in the United Kingdom (Kramer, 2000). SGA may be a normal fetal response to lack of nutrition or oxygen in uterus. Not only fetal factors (e.g., chromosomal disorders, infections, etc.), but also maternal conditions (e.g., malnutrition, chronic illness, sickle cell anemia, etc.) can be associated with SGA (Kliegman, 2012). In this study, unlike preterm birth and low birth weight, the proportion of SGA was higher in the

immigrant group even after adjusting for socioeconomic factors, albeit the absolute values were decreased. This means that not only socioeconomic factors, but also health status of mothers may affect higher proportion of SGA. Racial or constitutional difference in birth weight is known to affect SGA (Kramer, 2000). However, as the international standard growth chart, the Fenton growth chart, was used to determine the percentile of birth weight, racial or constitutional differences were not reflected in this study. And maternal weight gain during pregnancy, one of the most important factor for SGA was not assessed. Therefore, there are limitations to estimate the reason of this result. However, SGA is known to be important cause of chronic diseases in adults, such as coronary heart disease, stroke, diabetes and hypertension. Therefore, it is important to evaluate mother's health status and follow up SGA babies for preventing chronic diseases (Barker, 1998).

In the subgroup analyses, the proportions of very preterm (gestational age <32 weeks) and very low birth weight (birth weight <1,500 g) were higher in the native group. To clarify the meaning of these results, we need more information regarding maternal perinatal history, such as the use of assisted reproductive technology or presence of maternal conditions (e.g., preeclampsia or chorioamnionitis) (Martin et al., 2014; Schieve et al., 2002; Wang et al., 2005).

In the subgroup analyses according to maternal original nationalities, the results were similar with previous studies that immigrants from Asian countries have tendency to show adverse birth outcomes (Gagnon et al., 2009; Urquia et al., 2015). Nevertheless, the results were quite different according to countries in Asia. In Table 5, immigrant women from China showed more favorable birth outcomes, compared to native women. In this study, immigrants from China accounted for 26.4% in the immigrant group, and according to a report about marriage based immigrant women in Korea,

Korean Chinese constituted approximately 60% in Chinese immigrants in Korea (Korean Women's Develoment Institute, 2013). They are known to have less language problems and more knowledge in Korean culture, and lower barriers to approach social welfare system (Choi, 2007). This might influence their settlement in Korean society and using health care system, and it might affect their favorable birth outcomes. Immigrant women from Southeast Asia showed tendency to have less favorable birth outcomes, compared to the native women (Table 6). Women from Southeast Asia accounted for 61.1% in the immigrant group and most of the countries are low- or low-middle income countries, and 86.5% of them graduated high school or below. Therefore, they might have poor pre-pregnant health condition, and many language challenges that could affect birth outcomes. Also, genetic factors and ethnic differences may cause these outcomes (Kramer, 1987; Urquia et al., 2015). On the other hand, immigrant women from Europe or America showed similar birth outcomes, compared to Korean native women (Table 7, 8). Even 73.9% of European came from low- or low-middle income countries and 47.4% of them are less educated, their birth outcomes were comparable to those in the native group. Genetic and ethnic factors can be reasons of these results though it was difficult to explain in this study. Approximately 77% of immigrants from America, their spouses were manager, specialists, or officers, on the contrary, only 32% for Asian immigrants (data were not shown). These differences in occupation might affect economic status of the immigrant group and result favorable birth outcomes.

Differences in birth outcomes between immigrant and native group were especially pronounced among women who were primipara or 20–35 years old. In the present study, the mean period from marriage to the first birth was 1.1 years in the immigrant group (data not shown), which indicates that immigrant women might not have had sufficient time to adjust to Korean society before their first pregnancy.

Furthermore, these women might experience language challenges, have low health literacy, and have low social status, which might affect their ability to obtain perinatal healthcare. In contrast, the birth outcomes among multipara women were comparable in the immigrant and native Korean groups, which might indicate that a longer duration of residency in Korea improved birth outcomes in the immigrant group. However, the proportion of SGA was significantly higher in the immigrant group among multipara women, and it may be affected by racial or constitutional differences.

D. Comparing the vulnerable immigrant and native Korean groups

When birth outcomes in the immigrant group and the vulnerable native Korean group (low education level or unemployed status) were compared, the native Korean group exhibited higher proportions of preterm birth. One of possible reasons that should be considered is relatively higher social support for immigrants compared to the vulnerable native groups. Immigrant women are categorized as vulnerable group in Korea and have better defined boundary than the disadvantaged native group. Therefore, it might be easy to apply support policies for local governments or non-governmental organizations for them, compared to less educated or unemployed natives. Previous studies also explained better birth outcomes of immigrants with greater levels of social supports that buffer the harmful effects of low socioeconomic status of immigrants (Auger et al., 2008; Janevic et al., 2011). The healthy migrant effect can be other reason of these results. Because, especially in the less educated group, the effect is more prominent than in the advantaged group (Auger et al., 2008). These results indicate that policies should embrace all disadvantaged groups, in order to provide equal access to qualified perinatal healthcare and to prevent adverse birth outcomes. Furthermore, to reduce the incidence of preterm birth and

low birth weight, women should quit smoking, avoid alcohol, consume a healthy diet, and regularly obtained prenatal care (Alexander & Korenbrot, 1995; Centers for Disease Control and Prevention, 2015). In 1974, the American government initiated a special supplemental nutrition program for women, infants, and children, which provides supplemental food, healthcare referrals, nutrition education, and breastfeeding promotion to women with low incomes, infants, or children who may have a high risk of poor nutrition. To accommodate immigrant families, information regarding this program is provided in nine languages. Prenatal participation in the program was positively associated with gestational age and mean birth weight, and was negatively associated with the incidence of low birth weight (the United States Department of Agriculture, 2015). In addition, some American states have implemented a 'Nurse-Family Partnership' program, in which registered nurses visit low-income and first-time mothers' homes 64 times during their pregnancy and until the child reaches the age of 2 years. The nurses provide preventive healthcare, prenatal practice, health and development education, and life coaching, and this program has been estimated to reduce the rates of smoking during pregnancy and preterm births, and to increase birth weight and the use of formal community health services (Olds, 2006). The British government also introduction a similar program in 2007, which was provided to first-time mothers who were <19 years old (Department of Health, 2015). In 2005, the Korean government developed 'Nutriplus program' for low-income families, which provides nutritional education, supplemental foods, and regular nutrition check-ups. However, the effectiveness of this program has not been evaluated, and there are few polices that support pregnant women in disadvantaged groups (Ministry of Health and Wealth, 2015). Therefore, it appears appropriate to evaluate the existing Korean policies and establish new policies, such

as home-nursing care, in order to support women who had a low socioeconomic status and/or are immigrants.

E. Multivariate analyses of factors that were associated with birth outcomes.

The multivariate analyses among the immigrant group (Table 10) revealed that male sex was associated with a higher risk of preterm birth and a lower risk of low birth weight, and previous studies have reported similar outcomes. Differences in the infant's sex may affect the uterine environment and result in preterm birth, and there are sex-specific differences in fetal fat sensitivities to hormones and the production of testosterone, which may result in male infants being heavier at birth (Di Renzo et al., 2007; Zeitlin et al., 2002). However, this theory remains debatable, and other studies have concluded that the infant's sex did not affect preterm birth and birth weight (Kramer, 1987), and a risk of SGA was higher in male infants. Immigrant mothers who were ≥35 years old had higher risks of adverse birth outcomes. These results are consistent with the findings of previous studies, and indicate that routine antenatal surveillance is needed for this age group (Cleary-Goldman et al., 2005; Hansen et al., 2012; Kramer, 1987). Risks of these outcomes were not decreased according to whether they gave birth in metropolitan cities or not. Therefore, support policies should be nationalized rather than concentrated on specific area. Contrary to the native group, risks were not significantly differed according to parent's educational level or occupations. Primipara women had a higher risk of low birth weight and SGA, and women from low-/lower-middle-income countries had higher risks of preterm birth and low birth weight. These results show that health status may affect birth outcomes more than socioeconomic status in

Korea. Especially, the mother's pre-immigration and early post-immigration statuses (health status, social support) may affect birth outcomes and more researches are needed.

Factors that may be associated with birth outcomes among native women are shown in Table 10 and the results were consistent with previous studies that explained above (Astolfi et al., 2006; Cleary-Goldman et al., 2005; Kramer, 1987; Shin et al., 2012). The results in multivariate analysis for all births in Korea revealed that immigrant women had lower risks for preterm birth and low birth weight. Even though the proportions of preterm birth and low birth weight were higher in the immigrant group before adjustment or in the limited adjustment, the results were opposite after adjusting for all factors. This means that these demographic and socioeconomic factors may affect the gap of birth outcomes between two groups. These results were corresponded to the results of adjusted proportion in this study and the results of previous studies, and we cannot exclude possibility of healthy migrant effect, therefore further researches for health status of immigrant women are needed (Frank & Hummer, 2002; Gagnon et al., 2009; Guendelman et al., 1999; Tsimbos & Verropoulou, 2011). Otherwise, risk of SGA was highest in immigrants from low and lower-middle income countries and racial or constitutional characters may affect this. Identifying reason of high risk of SGA in this group and following up for long term outcomes of SGA are needed.

F. Limitations and implications

There are several limitations that should be considered when interpreting these findings. First, data from a mandatory birth registry were used, although it does not contain all relevant maternal and infant data. For example, additional information

regarding maternal health (pre-pregnancy body mass index, hemoglobin levels during pregnancy, blood pressure, presence of sexual transmitted disease, and smoking) and infant health (congenital disease, intrauterine infection, and chromosomal disorders) might allow for a more precise assessment of the effects of socioeconomic factors and physical conditions (Goldenberg et al., 2008; Kramer, 1987). Second, as birth registry is not allowed for illegal immigrants, so birth outcome of illegal immigrant group were not assessed. There are approximately 200,000 illegal immigrants in Korea in 2014 and it is difficulty to access Korean health care system for them (Statistics Korea, 2015). Therefore, there might be problems in perinatal health care in this group and researches are needed for this group. To do that, making policies for official registry system for infants from illegal immigrants is necessary. Third, information regarding socioeconomic status was limited to education and occupation, and additional information regarding financial status and possessions might be used for more precise socioeconomic classifications (Caro & Cortés, 2012; Tello et al., 2005), which would provide additional data to support further policy improvements. Fourth, data regarding other birth outcomes, such as stillbirth, miscarriage, or infant mortality, were not accessible. These data would be important for assessing the perinatal environment and developing integrated policies that address the entire perinatal period. Fifth, data regarding the durations of the immigrant mothers' residency in Korea were not accessible, although primipara immigrant women are speculated to have shorter durations than multipara women. If data regarding residency durations were accessible, it would be possible to classify immigrants using this data, and to provide more appropriate support based on their characteristics and needs. Therefore, a more detailed birth registry is needed to provide additional information regarding infants with preterm birth and/or low birth weight. For example, the Korea National Research Institution of Health and The Korean Society of

Neonatology established a national prospective registry of very low birth weight infants (birth weight <1,500 g) in 2013 (Chang, Ahn, & Park, 2013), although that registry contains very little data, and is limited to very low birth weight infants. Thus, government support in modifying and expanding that registry to incorporate information regarding cases of low birth weight or preterm birth is recommended, which would provide the relevant data for more detailed assessments of at-risk groups and adverse birth outcomes.

Despite these limitations, this study also has several strengths. First, this is the first study to evaluate and compare the birth outcomes among immigrant and native women in Korea, and there are no other data that can be used to evaluate the policies that have been developed to support immigrant women and achieve positive birth outcomes. These findings revealed a high risk of preterm birth, low birth weight and SGA among immigrant women, especially from Southeast Asia and these differences were further magnified among women who were primipara or 20–34 years old. Furthermore, these findings revealed several demographic factors that were significantly associated with adverse birth outcomes. Second, birth outcomes from the immigrant group and a vulnerable group of native Koreans were compared, and found that the immigrants group exhibited more favorable birth outcomes than their native counterparts. Therefore, it appears that policies should be developed to support both immigrants and disadvantaged native groups, such as parents with low education or parents who are unemployed. Third, it is expected that the number of immigrants will continue to increase, which highlights the importance of identifying disparities in women's status and birth outcomes. These results can provide baseline data for policies that support immigrants successfully settling in Korea, living healthy lives, and experiencing positive birth outcomes, which can help reduce the economic

burden on the immigrants and the Korean healthcare system.

G. Conclusions

Hypotheses of this study were the proportions of adverse birth outcomes would be higher among immigrant women, compared to those among native Koreans, and there would be socioeconomic factors that are related to those birth outcomes in the immigrant group. This study has provided evidence regarding the disparities in the risks of preterm birth, low birth weight and SGA among immigrant women and native women in Korea. Especially there was higher risk of SGA among immigrant group and immigrants from Southeast Asia were most vulnerable. Otherwise, several results of analyses showed possibility of the health migrant effect. There were weak correlations between socioeconomic factors such as education level and occupations of parents, and effect on birth outcomes of these factors were not significant while pre-immigration and early post-immigration statuses may significantly affect birth outcomes. However, there are several limitations in this research thus to accurate assess the precise status of birth outcomes, thus to identify the causes of adverse birth outcomes, additional information regarding perinatal health and socioeconomic factors is needed. Therefore, it would be helpful to develop a more comprehensive national birth registry or to evaluate birth cohort of immigrant women who have more available data. Furthermore, qualitative research regarding immigrant women can provide additional detailed information regarding their unmet needs during the perinatal period. Moreover, future studies should examine additional health conditions (beyond birth outcomes) among immigrants, such as infant mortality, developmental delay, and growth retardation. These data will be necessary to develop comprehensive policies that reduce health disparities and support the successful settlement of immigrants in Korea.

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국문초록

대한민국에 거주하는 이주 여성의 부정적 출산 결과 현황과 위험인자 분석

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연구배경

지난 20년간 대한민국에 거주하고 있는 이주민의 수는 급격히 증가하였으며 이주 여성으로부터 출생하는 아동의 수도 증가하여 연간 출생 수의 약 4.3%를 차지하고 있다. 하지만 이주 여성에서의 미숙아, 저체중출생아 및 부당경량아 출산 현황에 대한 정보는 현재까지 많지 않다.

연구방법

본 연구는 2010년부터 2013년까지 통계청에 등록된 출생자료를 분석하여 이주여성으로부터 출생한 68,074명의 단태아와 대한민국 여성(내국인)으로부터 출생한 1,644,956명의 단태아에서 미숙아, 저체중출생아 및 부당경량아의 비율 및 관련 인자를 비교 분석하였다. 또한 엄마의 출신 국가, 나이, 출산력, 출생 지역 등에 따라 하위군 분석을 하여 어느 군에서 비율의 차이가 큰지 알아보았고, 이주 여성과 내국인 중 취약계층과도 비교해보았다. 그리고 관련 인자를 확인하고자 인구, 사회경제적 요인으로 다항 분석을 시행하였다.

연구결과

출산 관련 인자(아기의 성별, 엄마의 나이, 결혼 상태, 출산력)로 보정하여 두 군을 비교하였을 때 미숙아(4.9% vs. 4.6%, $p < 0.001$), 저체중출생아(4.2% vs. 3.6%, $p < 0.001$), 부당경량아(5.7% vs. 7.2%, $p < 0.001$)의 비율은 이주 여성에서 의미 있게 높았다. 하지만 사회경제학적 요인(출생 지역, 부모의 교육 수준, 직업)으로 추가 보정하였을 때에는 이주 여성에서 의미 있게 낮았으나 부당경량아의 비율은 의미 있게 높았다. 이러한 결과는 동남아시아에서 온 이주 여성에게서도 유사하게 나타났으나 중국, 유럽, 아메리카에서 온 경우에는 미숙아, 저체중출생아 및 부당경량아의 비율이 내국인과 비슷하거나 오히려 낮았다. 하위군 분석 시에는 초산과 엄마의 나이가 20 ~ 34세 일 때 이주 여성에게서 의미 있게 그 비율이 유의하게 높은 것으로 확인되었다. 내국인 중 부모의 교육 수준이 고졸 이하이거나 아버지가 무직인 경우와 이주 여성을 비교하였을 때에는 이주 여성에서 미숙아 출산률이 낮았고, 저체중출생아의 비율은 두 군에서 유사하였다. 다항 분석에서는 아기의 성별, 부모의 나이, 엄마 출신 국가의 경제적 수준이 미숙아 및 저체중출생아의 출산 위험과 관계가 있는 것으로 예상 되었으며 인구, 사회경제적 요인으로 모두 교정하였을 때에는 미숙아 및 저체중출생아 출산의 위험이 이주 여성에서 더 낮았으며 부당경량아의 출산 위험은 더 높았다.

결론

이번 연구를 통하여 이주 여성과 내국인 여성에서 미숙아, 저체중출생아 및 부당경량아 출산 비율의 차이가 있음을 확인할 수 있었다. 정확한 현황 파악 및 원인 파악을 위해서는 산모 및 아기의 건강 상태 등에 대한 추가적 정보가 필요하다. 이 연구는 이주민의 성공적인 정착과 건강불평등을 줄일 수 있는 정책 마련의 기초 자료가 될 수 있을 것으로 기대한다.

… …

주요어 : 이주 여성, 미숙아, 저체중출생아, 부당경량아, 건강 불평등, 대한민국

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